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September 1970

GEORGE C. MARSHALL SPACE FLIGHT CENTER

FY 1970 SCIENTIFIC AND TECHNICAL REPORTS ARTICLES, PAPERS, AND PRESENTATIONS

Management Services Office

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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ABSTRACT

This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY 70. It also includes papers of MSFC contractors.

After being announced in STAR or C STAR, all of the NASA series reports listed may be obtained from the Scientific and Technical Information Facility, P. O. Box 33, College Park, Maryland 20740.

The information in this report will be of value to the scientific and engineering community in determining what information has been published and what is available.

A&TS-MS-I-70-01 September 1970

FY 1970 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS

Scientific and Technical Information Division
Management Services Office

FOREWORD

In accordance with the NASA Space Act of 1958 the MSFC has provided for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Since July 1, 1960, when the George C. Marshall Space Flight Center was organized, the reporting of scientific and engineering information has been considered a prime responsibility of the Center. Our credo has been that "research and development work is valuable, but only if its results can be communicated and made understandable to others."

GEORGE C. MARSHALL SPACE FLIGHT CENTER
Marshall Space Flight Center, Alabama

FY 1970 SCIENTIFIC AND TECHNICAL REPORTS ARTICLES, PAPERS, AND PRESENTATIONS

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TM X-53859 July 8, 1969

Lunar Excursion Module RCS Engine Vacuum Chamber Contamination Study. Gary M. Arnett, Technical Coordinator. Space Sciences Laboratory. N70-13418.

The objective of this study was the definition of future contamination studies and procedures, and the investigation extended to the effects of the Reaction Control System (RCS) plume on optical flight experiments. This report is concerned with the effects of the RCS plume deposits on the test beds along with the characteristic changes that occur once these deposits are exposed to the laboratory atmosphere. Test beds consisting of various optical surfaces were exposed to an LM-RCS rocket engine plume in the vacuum chamber A. Analysis of the contaminated test beds included optical measurements ranging from the near-ultraviolet through the far-infrared region together with mass spectrometer identification of the deposits.

TM X-53865 October 31, 1969

Natural Environment Criteria for the NASA Space Station Program. Don K. Weidner, ed. Aero-Astrodynamics Laboratory.

This document provides natural environment criteria for the NASA Space Station Program with emphasis on the 1975-1985 time period. Information in the disciplinary areas of atmospheric and ionospheric properties, radiation, solar cycle predictions, geomagnetic field, astrodynamic constant, and meteoroids is given for the Earth, Moon, Mars, Venus, and interplanetary space. This document, originally published on August 1, 1969, has been revised to include the planetary and lunar environment criteria needed for preliminary Space Station studies relative to a manned Mars landing, a Venus flyby, and a lunar mission. It supersedes earlier versions of NASA TM X-53865.

TM X-53866 August 12, 1969

Z Transform and the Use of the Digital Differential Analyzer as a Peripheral Device to a General Purpose Computer. Donald Nalley. Computation Laboratory. N70-19896.

A feasibility study determined whether the Digital Differential Analyzer (DDA) can be used as a peripheral device; that is, a computer system programmed in FORTRAN IV or some other standard language in which certain manipulations could be accomplished on the DDA by calling a subroutine. In this study, consideration was given to Large Scale Integrator Circuits (LSI), because it was felt that suitable LSI would make the DDA a more feasible device.

It appears that the DDA as a standard peripheral device with automatic patching is indeed feasible. However, implementation with LSI is questionable presently, but this may become feasible soon.

TM X-53867 May 12, 1970

Probability Distributions for Thunderstorm Activity at Cape Kennedy, Florida. Lee W. Falls, William O. Williford, and Michael C. Carter. Aero-Astrodynamics Laboratory.

Several statistical distribution functions are investigated as prospective models to represent the variation of thunderstorm activity at Cape Kennedy, Florida. Statistical methods are presented using the latest and most comprehensive thunderstorm data available. The conclusion is reached that the negative binomial distribution and a modification of the negative binomial distribution are adequate statistical models to represent "thunderstorm events" and "thunderstorm hits," respectively, at Cape Kennedy, Florida.

TM X-53868 August 27, 1969

Studies in System Simulation. R. Saeks. NASA-ASEE Summer Faculty Fellowship Program. N69-41152.

The results of three mathematical studies of the feasibility of various methods of large scale digital system simulation are reported. Specific studies deal with the effects of applying numerical techniques directly to the components of a system, approximation techniques for reducing the order of subsystems, and data compression techniques for the computer storage of the large topological matrices encountered in system simulation.

TM X-53870 August 26, 1969

A Direct Measurement of the Most Probable Preferred Angular Velocity of Turbulent Structures by Optical Correlation of Laser Schlieren Signals. B. H. Funk. Aero-Astrodynamics Laboratory. N70-12209.

A method which potentially provides the means for separating the translational and rotational motion of turbulent structures is introduced. Simple two-dimensional models are used to relate the skewness of cross-correlograms computed from laser schlieren signals to the rotation of flow disturbances. The method, referred to herein as the method of "forced similarity," is discussed with respect to application to the turbulent free shear layer of an axisymmetric supersonic jet. Experimental results show that the shape of the cross-correlogram in the neighborhood of the "peak" is strongly influenced by rotational motion, and therefore, it becomes necessary to account for the effect in order to determine the correct statistical properties of the turbulence.

TM X-53871 September 5, 1969

Experiments in Hydrodynamic Grease Bearings. John L. Burch and Peter H. Broussard, Jr. Astrionics Laboratory. N70-11874.

The suitability of using hydrodynamic conical- and spherical-shaped spiral-grooved grease bearings as a replacement for gyro ball bearings has been investigated. Grease bearings have been built and tested for rotors which vary in diameter from a few centimeters to 30.5 centimeters and in weight from a few grams to 22.7 kilograms. Speeds from 12 000 to 50 000 rpm have been maintained for hundreds of hours in both air and vacuum environments. Generally, these bearings have operated satisfactorily and retained their lubricant.

TM X-53872 September 8, 1969

Terrestrial Environment (climatic) Criteria Guidelines for Use in Space Vehicle Development, 1969 Revision. Glenn E. Daniels, ed. Aero-Astrodynamics Laboratory. N70-16998.

Guidelines on probable climatic extremes and probabilities-of-occurrence of terrestrial environment data specifically applicable for NASA space vehicles and associated equipment development are presented. The geographic areas encompassed are the Eastern Test Range (Cape Kennedy, Florida); Huntsville, Alabama; New Orleans, Louisiana; the Western Test Range (Point Arguello, California); Sacramento, California; Wallops Test Range (Wallops Island, Virginia); White Sands Missile Range, New Mexico; and intermediate transportation areas. In addition, sections have been included to provide information on the general distribution of natural environment extremes in the United States (excluding Alaska and Hawaii), cloud cover, and some worldwide climatic extremes.

TM X-53873 October 1, 1969

Optimal Transfer Trajectories From Earth Parking Orbit to Various Terminal Conic Constraints and Modifications to the ROBOT Computer Program. Rodney Bradford. Program Development. N70-15035.

Reference optimal (minimum fuel consumption) transfer trajectories were computed by the minimum Hamiltonian-steepest ascent method for departure from a circular parking orbit about the earth to various terminal conic constraints. Terminal conditions were a circular orbit at synchronous altitude, 35 862 km, an elliptical orbit with apogee at synchronous altitude (in-and-out-of-parking-orbit-plane), and an injection burn into a typical 1973 Mars mission hyperbolic orbit. The vehicles used to perform these transfers were the S-IVB stage and the Command Service Module. Also included is a typical ascent trajectory profile utilizing a two-stage Saturn IB launch vehicle. Detailed orbital and trajectory profile parameters are presented in tabular form.

TM X-53874 September 9, 1969

Infrared Testing of Electronic Components. E. G. Osburn. Quality and Reliability Assurance Laboratory. Converted from IN-R-QUAL-67-2.

NASA TECHNICAL MEMORANDA

TM X-53875 September 9, 1969

Determination of Mass Characteristics S-IC-2. T. A. Henegar. Quality and Reliability Assurance Laboratory. Converted from IN-R-QUAL-67-3.

TM X-53876 September 9, 1969

Parallel Gap Welding. A. M. Pasciak. Quality and Reliability Assurance Laboratory. Converted from IN-R-QUAL-67-6.

TM X-53877 September 9, 1969

Evaluation of Postsoldering Cleaning Agents. F. C. Osemlak. Quality and Reliability Assurance Laboratory. Converted from TM X-53877.

TM X-53878 September 9, 1969

Final Report: Leak Detector Development (contract NAS8-11898). Quality and Reliability Assurance Laboratory. Converted from IN-R-QUAL-67-9.

TM X-53879 September 9, 1969

Evaluation Testing of Thermofit Solder Sleeves. Quality and Reliability Assurance Laboratory. Converted from IN-R-QUAL-67-10.

TM X-53880 September 9, 1969

Evaluation of Radiographic Flaw Detection in 2219 Aluminum Tig Welds. Tom Goldsberry and Jerry Barnes. Quality and Reliability Assurance Laboratory. Converted from IN-R-QUAL-67-19.

TM X-53881 September 12, 1969

Monitoring Airborne Particulate Contamination. T. W. Lewis. Manufacturing Engineering Laboratory. Converted from R-ME-IN-67-1.

TM X-53882 September 12, 1969

Titanium 8A1-1Mo-1V Crossbeam Repair. Ronald L. Nichols. Manufacturing Engineering Laboratory. Converted from R-ME-IN-67-3.

TM X-53883 September 12, 1969

Space Tool Power Source Investigation. Manufacturing Research Technology Division. Manufacturing Engineering Laboratory. Converted from R-ME-IN-67-4.

TM X-53884 September 12, 1969

Sterilization of Unmanned Planetary Spacecraft: A Report on Current Technology. F. J. Beyerle and E. B. Snow. Manufacturing Engineering Laboratory. Converted from R-ME-IN-67-5.

TM X-53885 September 12, 1969

Effect of Current Cleaning Procedures on Sterilization of Spacecraft Components. Manufacturing Research and Technology Division. Manufacturing Engineering Laboratory. Converted from R-ME-IN-67-7.

TM X-53886 September 12, 1969

Reaction of Encapsulating Foams to Specific Environmental Conditions. H. M. Walker. Manufacturing Engineering Laboratory. Converted from R-ME-IN-67-9.

TM X-53887 September 12, 1969

Simulation Test Report for Mass Transfer of Stowage Boxes Through the Airlock Module. Manufacturing Research Technology Division. Manufacturing Engineering Laboratory. Converted from IN-R-ME-67-11.

TM X-53888 September 12, 1969

Simulation Test Report for the Multiple Docking Adapter Package-Fastening Devices. Manufacturing Research and Technology Division. Manufacturing and Engineering Laboratory. Converted from IN-R-ME-67-12.

TM X-53889 September 12, 1969

Space Tool Power Source Safety and Reliability Investigation. Manufacturing Research and Technology Division. Manufacturing Engineering Laboratory. Converted from IN-R-ME-68-3.

TM X-53890 September 12, 1969

Roll Diffusion Bonding Development. Carl M. Wood. Manufacturing Engineering Laboratory. Converted from IN-ME-68-4.

TM X-53891 September 12, 1969

Evaluation of Alcohol Sporulation Method. Manufacturing Research and Technology Division. Manufacturing Engineering Laboratory. Converted from IN-R-ME-68-5.

TM X-53892 September 12, 1969

Development and Testing of the Lunar Gravity and Earth Orbital Simulator (Parallelogram). H. T. Blaise. Manufacturing Engineering Laboratory. Converted from IN-ME-68-13.

TM X-53893 September 12, 1969

Evaluation of Installation Variables for Titanium 6Al-4V Hi-Loks and Six-Wing Bolts Assembled in Titanium 8Al-1Mo-1V Sheet Material. Carl M. Wood. Manufacturing Engineering Laboratory. Converted from IN-ME-68-15.

TM X-53894 September 12, 1969

Simulation Test Report for MDA External Mobility Aids Evaluation. Space Simulation and Experiments Office. Manufacturing Engineering Laboratory. Converted from R-ME-IN-68-17.

TM X-53895 September 12, 1969

Simulation Test Report for Internal Mobility Aids Evaluation. Space Simulation and Experiments Office. Manufacturing Engineering Laboratory. Converted from R-ME-IN-68-18.

TM X-53896 September 12, 1969

A Study on the Use of Fighter Aircraft To Provide a Zero g Environment in Support of Space Manufacturing Experiments. Space Simulation and Experiments Office. Manufacturing Engineering Laboratory. Converted from R-ME-IN-68-19.

TM X-53897 September 12, 1969

Development of Methods for Application of Polyurethane Spray Foam Insulation Systems to Liquid Hydrogen Tanks. James M. Carter. Manufacturing Engineering Laboratory. Converted from IN-ME-69-3.

TM X-53898 September 11, 1969

A New Interpretation of the Explorer XVII and Explorer XXXII Ionization Gauge Data and Its Implications to Orbital Analysis. James O. Ballance. Aero-Astrodynamics Laboratory. N69-38272.

The response of the modified Redhead magnetron density gauges used on the Explorer XVII and Explorer XXXII satellites has been analyzed by using the transmission probabilities and time response characteristics caused by geometry and gas-molecule/surface interactions. It was found that the very evident fluid dynamic response characteristics of the data required an interpretation which uses low energy and momentum exchange for the gas on the initial wall collisions with total loss of atomic oxygen. An additional signal caused by a process — most likely to be recombination — taking place on the wall of the gauge is suggested. For the example used, there is a factor of two between the derived density based on the original assumptions and the density based on the new interpretation.

TM X-53899 September 11, 1969

Results of an Experimental Turbulent Boundary Layer Control Investigation. William W. Clever, II. Aero-Astrodynamics Laboratory. N70-11894.

Results of a wind tunnel test employing wall rougheners as a means of turbulent boundary layer control are presented. This method is demonstrated

as being simple, efficient, and capable of yielding predictable results. Boundary layer thickness increases on the order of 100 percent are shown to be possible without undue flow disturbance and velocity profile distortion. The results are compared with the theoretical growth of a turbulent boundary layer over a flat plate.

TM X-53900 September 12, 1969

Trajectory Application Method (TAM). John P. Sheats. Aero-Astrodynamics Laboratory. Converted from R-AERO-IN-1-67.

TM X-53901 September 12, 1969

Alternate Apollo Missions — Libration Points. John T. Wheeler. Aero-Astrodynamics Laboratory. Converted from R-AERO-IN-2-67.

TM X-53902 September 12, 1969

Derivation of Twelve-by-Twelve Stiffness Matrix for Shear Panel Undergoing Parabolic Deformation. Gary Muller. Aero-Astrodynamics Laboratory. Converted from R-AERO-IN-3-67.

TM X-53903 September 12, 1969

The Use of Statistics in Guidance Analysis. Donald H. Galli. Aero-Astrodynamics Laboratory. Converted from IN-AERO-68-2.

TM X-53904 September 12, 1969

Impulsive Velocity Requirements for Insertion Into Orbits About Venus, Mars, and Jupiter. Richard Gold. Aero-Astrodynamics Laboratory. Converted from IN-AERO-68-3.

TM X-53905 September 12, 1969

On the Real Singularities of the N-Body Problem. Hans J. Sperling. Aero-Astrodynamics Laboratory. Converted from IN-AERO-68-6.

TM X-53906 September 12, 1969

Discussion of Manual Control Problems. James H. Golmon. Aero-Astrodynamics Laboratory. Converted from IN-AERO-68-7.

TM X-53907 September 12, 1969

Aerodynamic Design and Calibration of the MSFC Thermal-Acoustic Jet Facility — Cold Flow Duct. K. D. Johnston and W. C. Tidmore. Aero-Astrodynamics Laboratory. Converted from IN-AERO-69-1.

TM X-53908 September 12, 1969

Preliminary Design Program for Advanced Planetary Spacecraft. J. T. Wheeler. Aero-Astrodynamics Laboratory. Converted from IN-AERO-3-69.

TM X-53909 September 12, 1969

Product Mean Values and Convection Speed. W. H. Heybey. Aero-Astrodynamics Laboratory. Converted from IN-AERO-67-8.

TM X-53910 September 12, 1969

Stress Corrosion Cracking Evaluation of Several Precipitation Hardening Stainless Steels. T. S. Humphries and E. E. Nelson. Astronautics Laboratory. N69-38232.

The stress corrosion cracking resistance of precipitation hardening stainless steels PH 13-8 Mo, PH 14-8 Mo, 15-5 PH, PH 15-7 Mo, 17-4 PH, 17-7 PH, A-286, Almar 362, AM-350, and Unitemp 212 are presented. Three types of specimens (round tensile, flat tensile, and C-rings) were employed and were subjected to alternate immersion in a 3.5-percent salt solution. The results indicate that under these test conditions, PH 13-8 Mo, PH 14-8 Mo, 15-5 PH, 17-4 PH, A-286, Almar 362, and Unitemp 212 stainless steels are highly resistant to stress corrosion cracking in practically all forms and heat treat conditions.

TM X-53911 September 16, 1969

Use of Low Constant Thrust To Accomplish Orbital Transfer. Quintin Peasley and Lester Katz. Space Sciences Laboratory. Converted from IN-SSL-N-68-8.

TM X-53912 September 16, 1969

Electron Transport From a Cosine Law Source. Charles E. Wuller, Jr. Space Sciences Laboratory. Converted from IN-SSL-N-68-13.

TM X-53913 September 16, 1969

Statistical Theory of Inelastic Neutron Energy Spectra. B. J. Henderson and C. E. Wuller, Jr. Space Sciences Laboratory. Converted from IN-SSL-N-68-14.

TM X-53914 September 16, 1969

The Gravitational Red Shift. Peter Eby. Space Sciences Laboratory. Converted from IN-SSL-N-68-19.

TM X-53915 September 16, 1969

A Brief Discussion of Berger's Latest Monte Carlo Program. J. H. Derrickson. Space Sciences Laboratory. Converted from IN-SSL-P-68-12.

TM X-53916 September 16, 1969

Solar Flow Parameters. Klaus Schocken. Space Sciences Laboratory. Converted from IN-SSL-T-68-4.

TM X-53917 September 16, 1969

A Microscopic Study of Solid/Liquid Phase Change in Several Members of the Paraffin Family. Barbara E. Richard and Tommy C. Bannister. Space Sciences Laboratory. Converted from IN-SSL-T-68-9.

TM X-53918 September 16, 1969

A Numerical Integration Scheme To Determine Hemispheric Emittance, Solar Absorptance and Earth Infrared Absorptance From Spectral Reflectance Data. Donald R. Wilkes. Space Sciences Laboratory. Converted from IN-SSL-T-68-10.

TM X-53919 September 16, 1969

Thermal Conductivity of a Particulate Sample in an Environment That Simulates the Planet Mars. James A. Fountain and Ronald W. Scott. Space Sciences Laboratory. Converted from IN-SSL-T-68-15.

TM X-53920 September 16, 1969

A General Survey of Classical Cepheid Variable Stars. Robert M. Wilson. Space Sciences Laboratory. Converted from IN-SSL-T-68-16.

TM X-53921 September 16, 1969

A Method for Simulating Van Allen Belt Proton Energy Spectra. John W. Watts, Jr. and Martin O. Burrell. Space Sciences Laboratory. Converted from IN-SSL-68-18.

TM X-53922 September 16, 1969

Film Degradation Resulting from Magnetically Trapped Protons in ATM Orbits. Space Sciences Laboratory. Converted from IN-SSL-N-69-2.

TM X-53923 September 16, 1969

Relativistic Time Dilation on Lunar Flights. Fred Wills. Space Sciences Laboratory. Converted from IN-SSL-N-69-4.

TM X-53924 September 16, 1969

Determining the Orientation of the Pegasus Satellites. Robert L. Holland, Fred A. Rodrigue, and Matthew B. Barkley, Jr. Space Sciences Laboratory. Converted from R-RP-INP-67-2.

TM X-53925 September 16, 1969

The Thermal Structure of the Sun. Klaus Schocken. Space Sciences Laboratory. Converted from R-RP-INT-67-3.

TM X-53926 September 16, 1969

An Application of Collisionless Ion Acoustic Wave Phenomena to Satellite Experiments. Lawrence H. Wood. Space Sciences Laboratory. Converted from R-RP-INN-67-4.

TM X-53927 September 16, 1969

Ion-and Diffusion-Pump High Vacuum Systems. Philip W. Tashbar et al. Space Sciences Laboratory. Converted from R-RP-INP-67-6.

TM X-53928 September 16, 1969

Heat Transfer in the Convective Envelope of the Sun. Klaus Schocken. Space Sciences Laboratory. Converted from R-SSL-INT-67-8.

TM X-53929 September 16, 1969

Analysis of the Effect of High Energy Protons on ATM Photographic Film. Russell D. Shelton. Space Sciences Laboratory. Converted from R-SSL-INN-67-9.

TM X-53930 September 16, 1969

The Heat Pipe Experiment. R. D. Shelton. Space Sciences Laboratory. Converted from R-SSL-INN-67-10.

TM X-53931 September 16, 1969

Comparison of Experimental and Theoretical Brightness Temperatures of the Lunar Surface for Different Elevation Angles of Sun and Observer. James K. Harrison. Space Sciences Laboratory. Converted from R-SSL-INT-67-11.

TM X-53932 September 16, 1969

Physics of the Clock Experiment. Russell D. Shelton, Nat Edmonson, Jr., and Fred Wills. Space Sciences Laboratory. Converted from R-SSL-INN-67-12.

TM X-53933 September 16, 1969

The Magnetic Field of the Sun and the Generation of Sunspots. Klaus Schocken. Space Sciences Laboratory. Converted from R-SSL-INT-67-13.

TM X-53934 September 16, 1969

Coordinate Systems in Relativistic Frequency Shifts of Atomic Clocks. Fred D. Wills. Space Sciences Laboratory. Converted from IN-SSL-N-67-14.

TM X-53935 September 16, 1969

An Analysis of Cassegrain Optics. Joe Michlovic. Space Sciences Laboratory. Converted from IN-SSL-T-67-16.

TM X-53936 October 10, 1969

Bolt Torque Tests in Vacuum. Keith E. Demorest. Astronautics Laboratory. N70-17607.

A report on test equipment and tests made to determine the effects of a vacuum environment on the release torque of various threaded fastener materials both lubricated and unlubricated is given. Results show the lowest release torques were obtained with steel bolts using an inorganically bonded dry film lubricant in vacuum while the highest release torques occurred with unlubricated steel fasteners in air.

TM X-53937 June 29, 1970

Effects of Sputtering Parameters on Teflon Thin Film Capacitors. R. I. Miller and R. C. Ruff. Astronautics Laboratory.

The effects of varying the radio frequency (rf) sputtering parameters on the dielectric properties of resultant deposited thin films of Teflon is discussed. Electrode voltage, electrode spacing, and sputtering pressure were the parameters studied, and film thickness was the controlled variable. The dielectric constant, dissipation factor, dielectric strength, and resistivity were determined. In general, the dissipation factor increases with film thickness, while resistivity and dielectric strength decrease with increasing thickness. All parameters measured indicate a strong anomaly at 3 000-Å film thickness.

TM X-53939 May 19, 1970

Radiographic Interpretation Guide for Aluminum Alloy Welds. P. C. Duren and E. R. Risch. Astronautics Laboratory.

The problem of radiographic interpretation has plagued the X-ray method of nondestructive testing since its beginning. In an attempt to achieve a more accurate interpretation of radiographic images of aluminum alloy welds, a program designed to correlate specific images with corresponding discontinuities was initiated. Radiographs were made of welds that contained different types of discontinuities. Subsequent metallographic studies were made to confirm the image types and shapes as depicted in the radiographs. These experiments required very precise welding techniques to produce the various types of discontinuities found in typical aluminum welds. Exact radiographic techniques and careful metallographic methods were also necessary to achieve program objectives. Lack of agreement on terminology has also plagued the advancement of radiographic interpretation. Therefore, the radiographic terms used in this report have been carefully defined to eliminate as many interpretational errors as possible. The resultant data show clearly that radiographic interpretation can be placed on a scientific basis.

TM X-53940 October 10, 1969

The Nondestructive Evaluation of Low Density Foam-Aluminum Composite Materials. W. N. Clotfelter, B. F. Bankston, P. C. Duren. Astronautics Laboratory. N70-17360.

NOPCO BX-250, a polyurethane spray foam is now used as cryogenic insulation for S-II stages of the Saturn vehicle. This application has required considerable effort in the development of nondestructive methods to evaluate the mechanical integrity of foam to metal bonds. Certain inspection problems associated with low density foam-aluminum composites are evaluated in this report. The development of audio frequency methods required to overcome these difficulties are described. Additional effort was required to adapt one of these audio frequency methods and to develop radiographic techniques for the detection of voids in the foam.

TM X-53941 October 17, 1969

Spectral Emission Properties of Selected Igneous Rocks in the 2.8- to 13.5-Micron Region. William D. Hunton. Space Sciences Laboratory. X70-13226.

Several laboratories are performing studies in the area of remote identification of rocks and minerals from their infrared reflections and emission spectra. The results of the studies should be useful in such programs as Apollo Applications. However, more laboratory data on known specimens are needed to identify rocks and minerals in situ.

In this report emission properties of selected igneous rocks in the 2.8- to 13.5-micron region are discussed. A circular variable filter wheel infrared spectroradiometer was used to obtain spectra from rough rock chunks heated to between 46° and 47° Celsius. The samples showed either several shallow emission minima or just a general departure from blackbody radiation. None showed any narrow bandwidth emission minima. This work has shown that the circular variable filter spectroradiometer is a useful tool in the field of identification of rocks whose temperatures are not highly elevated. It is useful in either distant or close scanning of rocks of unknown composition. Also, the spectra included should provide a useful catalog for work in infrared emission analysis.

TM X-53942 August 22, 1969

Nucleate Pool Boiling of Saturated Freon 113 in a Reduced Gravity Environment. Jerrol Wayne Littles. Astronautics Laboratory. N69-38608.

Pool boiling of Freon 113 was investigated in a body force field less than standard gravity using the 4-sec drop tower. Emphasis was placed on the behavior of the nucleate portion of the pool boiling curve. The growth and departure of individual bubbles were also investigated. A transient calorimeter technique was used to obtain boiling curve information. This technique allowed the use of a heater of sufficient size to eliminate the problem of heater geometry influencing the boiling behavior while avoiding the necessity of achieving steady state during the short drop time available. The results indicate that the location of the pool boiling curve is a function of both acceleration level and surface orientation.

TM X-53943 August 29, 1969

Celestial Coordinate Transformations. Nadine A. Bicket and Gilmer A. Gary. Space Sciences Laboratory. N70-12258.

Three FORTRAN programs required to give the coordinate transformations among the equatorial, ecliptic, and galactic systems are described. A brief review of spherical trigonometry is included. From the equations given for coordinate transformations and a development of the equatorial and ecliptic systems, a method for the general transformations was derived. These coordinate transformations were developed and programmed for use in the determination of the ecliptic (Zodiacal Light) with respect to the other systems for analysis of the S-073/T-027 AAP experiment data analysis.

TM X-53944 September 26, 1969

Design Sensitivities of Multistage Launch Vehicles. Dietrich W. Fellenz. Advanced Systems Office. Converted from IN-ASO-67-1.

TM X-53945 September 26, 1969

Parametric Sensitivity Analysis for Staged Propulsive Vehicles. G. R. Woodcock. Advanced Systems Office. Converted from IN-ASO-67-2.

TM X-53946 September 26, 1969

Staged Convoy Concepts in Lunar and Planetary Surface Exploration. Georg von Tiesenhausen. Advanced Systems Office. Converted from IN-ASO-67-4.

TM X-53947 September 26, 1970

Symmetric Round Trip Flybys to Outer Planets. G. R. Woodcock. Advanced Systems Office. Converted from IN-ASO-67-6.

TM X-53948 September 26, 1969

On Analysis of Area Coverage by Orbital Photoimaging Systems. G. R. Woodcock. Advanced Systems Office. Converted from IN-ASO-68-1.

TM X-53949 September 26, 1969

Preliminary Analysis of a Wake Trailing a Spacecraft. Walter H. Stafford and John P. Butcher. Advanced Systems Office. Converted from IN-ASO-68-3.

TM X-53950 September 26, 1969

A Graphical Approach to Convolution. James C. Taylor. Astrionics Laboratory. Converted from IN-ASTR-R-69-1.

TM X-53951 September 29, 1969

Mie Scattering: A Computer Program and an Atlas. Nadine A. Bicket and Gilmer A. Gary. Space Sciences Laboratory. N70-17291.

A brief background of Mie Scattering is given, with applications in distributions of particles and effects of different lens apertures of the flux-collecting device. A computer program, MIESCA, which calculates amplitude functions, efficiency factors, intensities, and polarizations, is listed, with adaptations for tape filing in the Univac 1108 and for plotting intensities and polarizations versus scattering angle on the SC 4020 plotter. An appendix on several numerical integrations and an atlas of scattering intensity graphs are included.

TM X-53952 October 21, 1969

A Stellar X-Ray Astronomy Summary and Bibliography. Robert M. Wilson, John M. Reynolds, and Stanley A. Fields. Space Sciences Laboratory. X70-12611.

This report represents a review of stellar X-ray astronomy. Tables and diagrams summarizing some of the results of the survey are shown. The right ascensions and declinations with special notes are presented for 57 X-ray sources. A tabulation of all X-ray flight experiments from the literature surveyed is shown. The report is of the annotated bibliographic, cross-referencing style.

TM X-53953 September 30, 1969

A Simplified Dead Reckoning Navigation System for the Manned Lunar Roving Vehicle. Walter L. Green. Astrionics Laboratory. N70-20655.

A dead reckoning navigation system for the manned lunar roving vehicle is presented. The basic hardware for the system is two free gyros mounted to the frame of the vehicle, the wheel odometers and tachometers, and a signal processor. The mathematical equations for the navigation system are developed and related directly to the vehicle velocity and the gimbal angle readings. A digital simulation program is written for the navigation system for performing error analysis. The simulation can be used for determining the effects of gyro drifts and system misalignments for any selected lunar surface profile. The results of a study with selected ranges of gyro drift rates and misalignments for a particular surface profile are given.

TM X-53954 August 22, 1969

Electron Bremsstrahlung Shielding at Synchronous Altitude by Electron Trapping in Dielectrics. D. L. Hollis. Space Sciences Laboratory. N70-15058.

A theoretical study is made of synchronous altitude electron bremsstrahlung shielding by electron trapping in a layer of dielectric material on the outer surface of a spacecraft. Traps in the insulating material retain bombarding electrons and thereby produce an internal spacecharge field of large magnitude. The electric field repels or slows additional electrons. This acts to reduce bremsstrahlung production, lower the photon energy, and enhance photon absorption. The breakdown phenomenon causes the shielding effect of the trapped electrons to be cyclic. Qualitative calculations indicate that a 40-percent decrease in mass results when a thin layer of polyethylene instead of lead is used in reducing bremsstrahlung in an aluminum wall to the same level. Suggestions are given to modify existing Monte Carlo codes for this particular application.

TM X-53955 1969

Meteoroid Physics Research at MSFC. Research Achievements Review. Volume III, No. 8. Science and Engineering.

TM X-53956 October 9, 1969

Cape Kennedy Wind Component Statistics Monthly and Annual Reference Periods for All Flight Azimuths From 0- to 70-km Altitude. S. C. Brown. Aero-Astrodynamics Laboratory. N70-15048

Head-, tail-, and cross-wind component speeds for Cape Kennedy are tabulated for all flight azimuths for altitudes from 0- to 70-km by monthly and annual reference periods. Wind speeds are given for 11 selected percentiles ranging from 0.135 to 99.865 percent for each reference period. The data were prepared for application to space vehicle dispersion analysis and pitch (or yaw) program bias to minimize vehicle structural and control loads caused by wind.

TM X-53957 October 17, 1969

Space Environment Criteria Guidelines for Use in Space Vehicle Development (1969 Revision). Don K. Weidner, ed. Aero-Astrodynamics Laboratory. N70-22208.

A cross section of natural environment data for use as design criteria guidelines in space vehicle development programs is presented. Specifically, information is provided in the disciplinary areas of atmospheric and ionospheric properties, radiation, solar cycle predictions, geomagnetic field, astrodynamic constants, and meteoroids for the earth's atmosphere above 90 kilometers, interplanetary space, and the atmospheres and surfaces (when available)

of the moon and the planets (other than earth) of this solar system. The current MSFC upper atmosphere model and solar cycle prediction routines are described in detail.

TM X-53958 October 14, 1969

Large Angle Method for Space Vehicle Angular Momentum Desaturation Using Gravity Gradient Torque. Hans F. Kennel. Astrionics Laboratory. N70-19867.

The angular momentum desaturation method is based on the use of the gravity gradient torques. Large angular maneuvers maximize the effectiveness of the desaturation method for the case where the mission requires the minimum moment-of-inertia axis to point toward some celestial object for the nonocculted part of the orbit. The desaturation method is developed under the assumption that the difference between two of the principal moments of inertia is negligible. A constant attitude with respect to the gravity gradient direction is held during the desaturation period. This allows maximization of the available gravity gradient desaturation torque which is necessary since the assumed moment-of-inertia distribution (in relation to the mission requirements) is a very poor candidate for angular momentum desaturation using the gravity gradient, especially when relatively large aerodynamic disturbance torques are present.

TM X-53961 November 21, 1969

Holographic Optical Data Processing. Rodney W. Jenkins. Space Sciences Laboratory. N70-17359.

To process optical data is to perform mathematical operations on optical inputs. This paper describes the holographic technique and its application to optical subtraction and pattern recognition (matched filtering). Also, experimental results that are presented verify the theory, and the appendixes show the Fourier transformation operator property of a lens and input translation invariance of the matched filtered output.

TM X-53962 1969

Computation Research at MSFC. Research Achievements Review. Volume III, No. 9. Science and Engineering.

TM X-53963 March 3, 1970

Investigation of the Development of Cracks in Solder Joints. Barnes Beasley. Astrionics Laboratory.

A study was made to investigate the development of cracks in solder joints on printed circuit boards and to recommend solutions to this problem. This study consisted of two approaches. One approach, an analytical investigation, was to perform a mathematical analysis of the joints in question with emphasis on the force applied to the solder joint; the second approach, an empirical investigation, was performed to determine the extent of damage caused by temperature cycling of printed circuit boards and to determine or evaluate the practical validity of the proposed solutions.

TM X-53965 December 12, 1969

Communication for the 70's. Scientific and Technical Information Division. Management Services Office.

These presentations were given at the Ninth Annual Society of Technical Writers and Publishers (STWP) and Association of Technical Artists (ATA) Seminar held in Huntsville, Alabama from October 21 to October 23, 1969. The report emphasizes the vital role of effective communication within technical fields. Scientific knowledge was disseminated through various media: reports, illustrations, presentations, and simple word of mouth.

TM X-53966 November 17, 1969

ARC Guidance Development Work for Tack-Welded Joints. James Chadbourne and W. A. Wall. N70-10699.

In an attempt to leap-frog long tack welds, a reliable tack weld detector was developed to sense approaching tack welds. This sensor is perhaps the most significant development to result from the phase of the program. It is concluded that the present MSFC system should not be located close to the torch when tack welds are employed to hold the weld joint; however, it is recommended that the present electro-inductive system should be considered a boon for the development of an automatic tack welder because of its homing capabilities. With a memory system, it seems feasible that the MSFC developed system could be used with short tack welds. As an evaluation and a comparison of MSFC's transducer with the latest optical tracking transducer is drawn to emphasize the strengths and weaknesses of each transducer.

TM X-53967 November 17, 1969

An Evaluation of Termi-Point Connectors. Quality and Reliability Assurance Laboratory. (Converted from IN-R-QUAL-66-28). N70-10500.

This report is a statistical evaluation of termi-point connectors and their adequacy for use in ground support equipment. Tests performed included vibration, physical shock, salt spray, gas seal, thermal shock, and humidity. Suitability for the intended purpose was demonstrated; however, it was felt that in certain critical areas and for flight conditions, a more dynamic test program should be conducted.

TM X-53968 November 17, 1969

Evaluation Testing of Thermofit Solder Sleeves. Quality and Reliability Assurance Laboratory. (Converted from IN-R-QUAL-67-10). N70-10599.

Data obtained during evaluation testing of thermofit solder sleeve D-101-31 when used on nickel clad copper wire and alloy 63 wire is discussed. The tests performed include voltage drop, peel strength, dielectric strength, water immersion, moisture resistance, high temperature aging and vibration. A test was conducted to determine the optimum heating time of the solder sleeve to obtain maximum peel strength of the joint. Another test, using additional flux was performed to obtain better wetting of the shield. It was found that very good wetting of the connection was obtained when the shield braid was prefluxed; however, tests indicated that a corrosive flux residue remained in the connection. Voltage drop and peel strength tests of stub splices, a combination of crimp ferrules and solder sleeves, were included.

TM X-53970 December 23, 1969

Development of Polymeric Fuel Tank Sealants for Advanced Aerospace Vehicles. William J. Patterson and Lawrence R. Moffett, Jr. Astronautics Laboratory. N70-17418.

This report describes studies in the development of a polymeric material capable of functioning as a fuel tank sealant in hypersonic aircraft. The preparation of a number of organic intermediates is outlined which encompasses a variety of systems including aryl-fluorinated compounds and aromatic polycyclic structures. Preliminary results indicate that incorporation of fluorine atoms into the basic polymer structure imparts a degree of aviation fuel resistance, a property which the sealant must of necessity possess. The rationale supporting the selected polymeric systems chosen for study and investigation is outlined in detail along with other pertinent factors involved in the selection of candidate materials. Supplemental studies involving the development of thermally resistant polymers as fuel tank sealants are described.

TM X-53971 November 19, 1969

Stress Corrosion Cracking of Ti-6Al-4V Titanium Alloy in Various Fluids. James G. Williamson. Astronautics Laboratory. Astronautics Laboratory. N70-15043.

An investigation of the stress corrosion susceptibility of Ti-6Al-4V alloy in various fluids was initiated because of the recent unexpected failures of this alloy in both nitrogen tetraoxide and absolute methanol. This study has indicated that Ti-6Al-4V alloy is susceptible to stress corrosion cracking in absolute methanol in both the annealed and solution treated and aged (STA) conditions. The threshold value for annealed material appears to be near 50 percent of the yield strength or approximately 70,000 psi, while the value of STA material is somewhat less. Long term exposure tests (two years) indicated that the Ti-6Al-4V alloy is not susceptible to stress corrosion cracking in acetone, Aerozine 50, distilled

water, absolute ethanol, Freon PCA, Freon MF, hydraulic oil (MIL-H-5606), absolute isoproponal, monoethyl hydrazine, RP-1 fuel and trichloroethylene.

TM X-53972 November 25, 1969

Traction Drive System Design Considerations for a Lunar Roving Vehicle. Clyde S. Jones, Jr., Billy J. Doran, and Frank J. Nola. Astrionics Laboratory. N70-18797.

For an optimum design, the weight, energy consumption, and operational flexibility of the traction drive system for a lunar roving vehicle must be considered along with the power supply, motor, and power train. Other problems considered in this paper include: environment and motor dissipation, motor type (i.e., ac or dc) and commutation if dc, motor controller (i.e., switching of large currents), delivery of torque at varying speeds, power train, use of regenerative braking and conservation of energy, and power supply voltage variation. These problems are studied in view of certain general system specifications, which fall into weight, performance, and environment categories. Tradeoff studies are considered for optimization in each of these areas. Special consideration is given to the controller and system design as it pertains to regenerative braking and the conservation of energy. Some aspects of changing the modes of motor operation to satisfy extreme performance requirements of speed and torque are discussed.

TM X-53973 June 30, 1970

Space Flight Evolution. Georg von Tiesenhausen and Terry H. Sharpe. Program Development.

This report describes a possible comprehensive path of future space flight evolution. The material in part originated from earlier NASA efforts to define a space program in which earth orbital, lunar, and planetary programs are integrated. The material presented is not related to specific time schedules but provides an evolutionary sequence. The concepts of commonality of hardware and reusability of systems are introduced as keys to a low cost approach to space flight.

TM X-53974 January 5, 1970

The Characteristics of Penetration for a Double-Sheet Structure With Honeycomb. David W. Jex, Archie M. Miller, and Charles A. MacKay. Space Sciences Laboratory. N70-25272.

The channeling of debris by a double-sheet structure separated by a honeycomb material has been reported by many investigators in the hypervelocity field. It has been suggested that this channeling will reduce the protective capability of such a structure when compared to an identical structure without honeycomb. A series of tests was conducted by this laboratory to gain an understanding of the characteristics of the channeling phenomena and the extent to which the channeling would affect the ballistic limit of a honeycombed structure. It was found that the particular honeycomb tested exhibited greater protective ability than an identical double-sheet structure without the honeycomb for velocities between 3.5 and 8.23 km/sec.

TM X-53975 January 9, 1970

Flat Conductor Cable Design, Manufacture, and Installation. W. Angele and James D. Hankins. Manufacturing Engineering Laboratory.

This report presents pertinent information for hardware selection, design, manufacture, and quality control necessary for flat-conductor cable interconnecting harness application. The relation of the hardware to the new MIL-C-55543 and MIL-C-55544 specifications for flat-conductor cable and flat-conductor cable connectors is defined. Comparisons are made between round-wire cable and flat-conductor cable. The flat-conductor cable interconnecting harness systems show major cost, weight, and space savings, plus increased system performance and reliability. The design application section includes electrical characteristics, harness design and development, and a full treatise on EMC considerations. Manufacturing and quality control sections pertain primarily to the NASA/MSFC developed conductor-contact connector system and special flat-conductor cable to round-wire cable transitions. This report presents flat-conductor cable technology as of June 1968 and predicts the role of flat-conductor cables in interconnecting harness applications for future programs.

TM X-53976 February 16, 1970

Conceptual Design of a High Energy Astronomy Observatory. Volume I: Preliminary Analysis. Volume II: Appendices. Program Development. Program Development. N70-22901.

The preliminary analysis and conceptual design of a baseline spacecraft along with supporting technical data and discussion of mission and spacecraft alternatives are presented.

The High Energy Astronomy Observatory treated in this work is the first of four planned spacecraft in the High Energy Astronomy Observatory program, designated in this report as HEAO-A. The primary mission objective of the HEAO-A spacecraft is to completely survey the celestial sphere for high energy X-rays, gamma-rays, and cosmic-rays, with primary emphasis on the galactic belt region; the secondary mission objective is selective pointing at specific celestial targets.

To ensure a comprehensive system analysis for feasibility assessment, a baseline mission and spacecraft was defined with a realistic, but hypothetical, experiment package. Total weight of the baseline spacecraft is approximately 19 000 pounds and launch is assumed from ETR on the Titan IIID launch vehicle in March 1974. The satellite is placed into a 200-n.mi. circular orbit with a 28.5-degree inclination; during the first month in orbit the slowly rotating satellite scans a region measuring ±8.5 degrees from the galactic plane; during the next 6 months the entire celestial sphere is scanned; and during the last 5 months of the first mission year the satellite employs a pointing mode for selected source investigations. Satellite design lifetime is 1-year minimum, with 2 years desired.

TM X-53978 January 19, 1970

Cryoformed 301 Stainless Steel for Pressure Vessels. C. N. Irvine. Manufacturing Engineering Laboratory. N70-22076.

The manufacture and qualifying results of cryogenically formed 301 stainless steel bottles for storage application, especially for helium in either a liquid oxygen or liquid hydrogen environment, are reviewed. No apparent distortion to the prototype vessels occurred during the course of testing. Survival of the test specimens through the qualification tests indicates that the developed manufacturing technology results in predictable properties and verifies the reliability of the techniques for the proposed applications. The cryoformed 301 stainless steel vessels should be considered for future launch vehicle and space applications, especially when weight is critical or a liquid or gaseous oxygen environment may be encountered or when temperatures vary from 394.3°K (250°F) to liquid hydrogen or helium temperatures.

TM X-53979 January 5, 1970

An Improved Method for Thin-Film Thickness Measurements. James L. Zurasky and Robert Forsten. Astrionics Laboratory. N70-19806.

An improved method of measuring thin films on metal by interpretation of interference fringes is described. The essential characteristic of the method is photographing an interference pattern produced by an interferometer; then, this negative is scanned by use of a microdensitometer to determine exact fringe location. Details of the method, expected accuracies, and possible improvements are outlined.

TM X-53982 December 22, 1969

Wind Determination Based on Eddy Transit Times Measured Between Four Nonintersecting Light Beams. W. H. Heybey. Aero-Astrodynamics Laboratory. N70-21988.

An atmospheric eddy crossing successively the lines of sight (beams) of two telescopes stays between them for a time that can be discovered through cross correlation of the light intensity variation recorded by the receivers. The length and location of the paths vary with the beam arrangement and with the wind vector which is taken as constant throughout a suitably bounded observation volume. At least four detectors are required for monitoring winds of unknown azimuthal direction. They are conveniently placed at the corners of a square sitting on level ground. Restraints determine the range in which an observed transit time triplet can be trusted to have been generated by one and the same wind, measured accurately enough to warrant the computation of its components from the expressions given for them.

TM X-53983 February 9, 1970

Fast Carry Accumulator Design. William C. Mastin. Astrionics Laboratory.

Methods for increasing the speed of binary addition by decreasing carry propagation time are reviewed. Particular attention is given to those methods that would be applicable to an accumulator using ones complements with end-around carry for subtraction. An iterative accumulator using pulse logic for input and carry signals is described. Realizations of gated carry, carry-completion detection, and carry-skip circuits that would be compatible with this accumulator are presented. NAND gates are used in the design of the required combinational networks.

TM X-53984 February 16, 1970

Calculations of Astrophysical Partition Functions. M. J. Hagyard. Space Sciences Laboratory.

A method for the calculation of the internal energy partition function of an atom or ion immersed in a plasma is presented. Sample calculations are made at various temperatures and electron pressures, and the numerical results are compared with those of other authors. The importance of the contributions of higher parent terms is clearly demonstrated.

TM X-53985 January 16, 1970

The Development of HXW Thermal Coating. Roger J. Harwell. Astronautics Laboratory. N70-18850.

The development of a coating for use on space vehicles to control their temperature while in a space environment is described. This is accomplished by varying the optical properties of the coating to control thermal absorption and emission rates of the vehicle surface. The inorganic coating described within this report has the capability of providing the necessary optical properties for thermal control and is also very stable in the environment of vacuum and solar radiation. The HXW coating is primarily a water suspension of synthetic mica that is gelled with a silicate solution. The products used in the coating are available from commercial sources and are relatively inexpensive for this type of coating.

TM X-53986 January 19, 1970

Contribution of the Spatial Part of the Metric Tensor to the Observed Frequency Shift in the Maser Clock Experiment. Peter Eby. Space Sciences Laboratory. N70-22124.

A formula for the frequency shift of a maser clock in orbit relative to an identical maser on the earth is derived. In addition to the usual terms, because of the gravitational potential difference and special relativistic effects, this formula is shown to contain terms that depend on the spatial part of the metric tensor. These extra terms cannot be derived using only the equivalence principle. It is shown that the frequency shift given by these additional terms appears to be observable with presently attainable maser accuracies. The measurement of the additional effects will yield the same information about the metric as will the geodetic precession of a gyroscope or the deflection of light.

TM X-53987 February 3, 1970

A Conceptual Design of the Space Shuttle Integrated Avionics System. Fred E. Digesu, ed. Program Development. N70-25104.

The status of an investigation to define an integrated avionics system for the Space Shuttle is presented. The system concept depicted for the integrated approach, based on subsystem requirements established early in the study, meets the mission requirements outlined in Shuttle Task Group reports and is compatible with the significant features of the vehicle configurations resulting from several 1969 contractor design studies. Included as part of the integrated avionics system is all Shuttle equipment that utilizes electronics in performance of the various functions required to accomplish the Space Shuttle mission. The individual subsystems are defined in varying degrees of detail and all data will be subject to change as the design work continues. Sufficient data are presented, however, to identify the significant physical characteristics, important performance values, functional block diagrams, and preliminary hardware selection for each avionics subsystem.

TM X-53989 January 31, 1970

Fifty-Man Space Base Population Organization. Georg von Tiesenhausen. Program Development.

An attempt is made to establish a baseline social and functional structure for a 50-man Space Base and to show how the requirements and activities of the personnel affect the Space Base layout.

TM X-53990 February 27, 1970

Torsional Vibration Analysis of Saturn Vehicles. Larry Kiefling and Frank Bugg. Aero-Astrodynamics Laboratory.

Methods for finding the torsional vibration modes for either a beam-like vehicle, such as Saturn V, or a multibeam vehicle, such as Saturn IB, are developed. The single beam analysis is a Stodola iteration method. The Saturn IB vehicle is mathematically modeled as a system of beams and connecting members. The modes of the vehicle are composed of the superimposed components of normal beam modes plus rigid body motion. A comparison is made with dynamic test data. The calculated frequencies differed from the experimental values by an average of 8 percent for the cases compared.

TM X-53992 February 2, 1970

A Systems Engineering Decision Algorithm With Application to Apollo Applications Program Integration Problems. C. E. DeSanctis. Astronautics Laboratory. N70-20093.

A decision algorithm, that has been specifically adapted to the needs of the System Engineer, is presented for resolving complex Apollo Applications Program (AAP) technical and management integration problems. An explanation of decision theory as applied to a technical problem and a detailed example of how the decision algorithm was used to determine the best location for the scientific airlock in either the orbital assembly's airlock module structural transition section, or the multiple docking adapter is submitted. It is concluded that alternate position number 1, located on the structural transition section, be chosen to resolve the AAP technical, operational, and management requirement problems.

TM X-53993 February 5, 1970

Space Processing and Manufacturing. Manufacturing and Engineering Laboratory. N70-20517.

Production engineering aspects of materials processing and industrial manufacturing are discussed with application to orbiting laboratories and orbital workshops. Analyzed are especially the effects of reduced gravity or weightlessness on production processes.

TM X-53994 February 6, 1970

A Collection of Lower Thermospheric (100- to 300-km-Altitude) Chemical Composition, Temperature, and Mass Density Data. Don K. Weidner and Michael T. Calloway. Aero-Astrodynamics Laboratory. N70-20367.

Atmospheric data were obtained by various investigators from 38 rocket-probe flights and two satellite-borne absorption spectrometers. The data sample is by no means complete, but should provide valuable inputs to studies concerning the structure and variability of the atmosphere. Atmospheric temperature, mass density, and constituent number densities of N_2, O_2, O, He, and H as calculated from the MSFC Modified Jacchia Model Atmosphere, 1967, for the conditions of a particular observation are tabulated from 120 to 1000 km for most of the observations. These data should also provide valuable inputs to various studies. In using these data, however, the investigator should consider the limitations (constant 120-km boundary conditions, empirical temperature, etc.) of the MSFC Model Atmosphere.

TM X-53996 February 12, 1970

The Generation of X Rays in Planetary Nebulae. Klaus Schocken. Space Sciences Laboratory.

The evolution of planetary nebulae and the production of X rays will be summarized from the literature. Planetary nebulae emit continuous radiation which originates by free-free transitions involving kinetic energy losses of free electrons in

the electrostatic fields of ions. These free-free emissions are responsible for the radiation observed in the radio frequency spectra. They also contribute in the visible and infrared regions. Therefore, if X rays are generated by planetary nebulae, it can be assumed that they will also be produced by free-free transitions. However, free-free radiation will be measured along with free-bound radiation. A formula is given for the intensity of the combined continuum for an ionized gas with a Maxwellian distribution of the electron velocities.

TM X-53998 March 13, 1970

X Radiation in Binary Stars. Klaus Schocken. Space Sciences Laboratory.

The properties of close binary stars and old novae as they are known will be summarized from the literature sources listed in the bibliography. A binary system originates with or results from the splitting of a single star into two components caused by rotational instability during the contraction of the star. The assumption is made that, to become a nova, it is a necessary condition for the star to be a member of a close binary system consisting of a blue and a red star, with a stream of gas flowing from the red to the blue star and forming a shell around the blue star to generate the observed bright emission lines that indicate that this gaseous shell moves with the blue star. Assuming that the explosive process has taken place in the nova, a shock wave will penetrate the surface, forming an expanded atmosphere in a time that is too short for appreciable loss of radiation. When an electric field exists in a plasma with a density such that the electrons whose velocity surpasses a certain critical value will gain more energy from the field than they lose by collisions, runaway electrons will be generated. The hypothesis is made that runaway electrons are the source of deceleration X radiation in the atmosphere of a nova.

TM X-64500 February 27, 1970

Space Shuttle Guidance. Wilton E. Causey. Aero-Astrodynamics Laboratory.

The guidance requirements for the Shuttle Vehicle and the possible candidate guidance schemes are discussed. The MASCOT Guidance Scheme appears to be ideally suited for the rendezvous guidance phase of the flight, and by modifying the guidance equation to include the lift and drag forces, the MASCOT scheme can be adapted for the ascent guidance phase. The basic parts of the MASCOT guidance scheme, a numerical integration algorithm and an iteration algorithm, can be used to develop a fast-prediction guidance scheme for the reentry phase.

TM X-64501 February 27, 1970

Some Photographic Results of the Apollo 11 Mission. Paul A. Larsen. Aero-Astrodynamics Laboratory.

The work reported in this document was done for several reasons: (1) to show what types of photographs are available as a result of the Apollo 11 mission; (2) to give the best possible photographic description of the lunar terrain in the vicinity of Tranquillity Base, and as many other areas of the lunar surface as possible, so that Lunar Roving Vehicle (LRV) mission planners, designers, and engineers can obtain a "feel" for several types of lunar terrain that may be encountered by the lunar roving vehicle; (3) to show some of the better pictures as single photographs, stereograms, constructed panoramic views, sequence strips, and mosaics; (4) to demonstrate the feasibility of making certain elevation measurements of lunar topographical features, by using lunar photographs, photogrammetric techniques, and locally available photogrammetric equipment; and (5) to provide a reminder of the value of high altitude earth photography for earth resources studies.

TM X-64503 March 11, 1969

Gravity Gradient Measurements with a Laser Absolute Gravimeter. R. C. Borden and O. K. Hudson. Space Sciences Laboratory.

A technique for measuring the gravity gradient is derived from extensions of Dr. Hudson's original theory employed in the laser interferometry method for measuring absolute gravity. The performance of the proposed experiment for measuring gradient is predicted through analyzing the effects from expected sources of measurement error.

NASA TECHNICAL MEMORANDA

TM X-64505 March 17, 1970

Research on Electromagnetic Correlation Techniques. Fritz R. Krause, ed. Aero-Astrodynamics Laboratory.

Advanced data processing and statistical analysis methods have been applied to output signals of active and passive electromagnetic sensors. Single path observations, intersecting beams, and separated lines of sight have been used to study the overall level, spectroscopic structure, and motion of local and remote optical disturbances. The potential of the associated "electromagnetic correlation techniques" is illustrated by model experiments in a jet, in a glow discharge, and in a blow torch. Analytical concepts for remote probing of the earth's atmosphere are illustrated through a discussion of special cross-beam arrangements for ground wind and turbulence detection. Potential applications to the general problems of separating dispersion phenomena from local photochemical processes are introduced through a piecewise accumulation of phase and gain spectra.

TM X-64506 April 17, 1970

An Approach to Contamination Identification. Dr. Thomas R. Edwards. Space Sciences Laboratory.

A regression analysis method has been applied to unfold the waveforms resulting from complex gaseous mixtures in mass spectral analysis. The output format specifies both qualitative and quantitative chemical analysis. This method of data analysis is applied towards optical contamination identification in vacuum systems. A number of test mixtures are presented to demonstrate the feasibility of the technique.

TM X-64507 February 27, 1970

An Analysis of Potential Space Shuttle Cargo-Handling Modes of Operation. Walter E. Whitacre. Program Development.

This report attempts to indicate the current status of Space Shuttle cargo-handling analysis. The problems involved in orbital docking, payload extraction and transfer, cargo handling, and special purpose missions are discussed and some tentative conclusions and recommendations are presented.

TM X-64508 April 15, 1970

Environmental Control and Life Support Subsystem (EC/LSS) for the 1975 Space Station. Hubert B. Wells. Program Development.

This report contains the results of a preliminary study to define an Environmental Control and Life Support Subsystem (EC/LSS) that is applicable to a long-term earth-orbital space station for the 1975 time period. The Space Station is capable of supporting a 12-man crew continuously over an extended period of time with regular resupply. The EC/LSS must maintain a system life requirement of 10 years through maintenance spares and redundancy. A survey was made to define a group of assemblies that is suitable for fulfilling the requirements of the EC/LSS. The primary assemblies are as follows: atmospheric supply and pressurization; oxygen recovery; atmospheric purification; thermal control; water management; water reclamation; waste management; suit loop/PLSS; crew systems; and expendables. This report contains detailed descriptions of primary assemblies, including design criteria, approaches, advantages, disadvantages, component descriptions, preliminary weight, volume, and power summaries, and other pertinent information.

TM X-64509 April 30, 1970

Experimental Development Program for Lunar Surface Navigation Equipment. Bobby F. Walls, William C. Mastin, and Peter H. Broussard, Jr. Astrionics Laboratory.

An examination of some of the proposed schemes for manned lunar surface navigation is made with overtones of unmanned navigation requirements. The examination is made with the view in mind of actual near-term implementation with available and proven hardware. An outline of MSFC's efforts in this area is given, with particular emphasis on the present, ongoing in-house design, fabrication, and testing of a candidate dead reckoning system utilizing gyro references. The ability of this system to meet the requirements of simplicity, reliability, low cost, and ruggedness is discussed.

TM X-64510 April 2, 1970

A Stress Corrosion Evaluation of AISI-H-11 Alloy Steel Plated With Nickel-Cadmium Coating. J. W. Montano. Astronautics Laboratory.

This report presents the mechanical properties of AISI - H-11 alloy steel bar specimens (0.125-in. diameter), C-ring specimens (1.0-in. diameter) and charpy V-notched impact specimens, heat treated to 220- to 240-ksi ultimate tensile strength range and plated with nickel-cadmium. The tensile specimens and C-ring specimens were stressed to 0, 50 and 90 percent and 25, 50 and 90 percent of the 0.2-percent longitudinal yield strength respectively, and exposed to: (a) 180 days of exposure to the atmospheric conditions prevalent at the Marshall Space Flight Center during the months of December through June, and (b) 180 days of alternate immersion (A.I.) testing in a 3.5-percent sodium chloride solution. Unplated control specimens were also used in the stressed and unstressed condition for comparison purposes.

TM X-64511 April 2, 1970

Stress Corrosion Cracking Evaluation of Several Ferrous and Nickel Alloys. T. S. Humphries and E. E. Nelson. Astronautics Laboratory.

The stress corrosion cracking characteristics of H-11 steel, Hastelloy C, Inconel 718, Waspaloy, music wire, and stainless steels Arde (cryoformed) low silicon 301, AISI 303, AISI 304, Armco 21-6-9 are described. Three types of specimens (round tensile, flat tensile, and C-ring) were employed and the main test environment was alternate immersion in 3.5-percent salt solution. The results of the test indicated that music wire, Hastelloy C, Inconel 718, Waspaloy, and stainless steels Arde 301, AISI 303, AISI 304 and Armco 21-6-9 in most forms and heat treat conditions are resistant to stress corrosion cracking in environments containing moist chlorides. However, another investigator has reported both service and laboratory stress corrosion cracking of cryoformed 301 stainless steel under different conditions. H-11 steel is susceptible to stress corrosion cracking in both moist chloride environments and semi-industrial atmospheres.

TM X-64513 April 30, 1970

Atmospheric Effects on Wave Propagation at 10.6 Microns. William E. Webb, Kermit H. George, and Peter Marrero. Astrionics Laboratory.

A CO_2 laser communications system using optical heterodyne detection has been operated over a 3.2-km path at the Marshall Space Flight Center. Both scintillation and heterodyne measurements were made for varying receiver apertures and under varying atmospheric conditions. The results have been analyzed to determine the statistical distribution function for the intensity fluctuations, the atmospheric structure constant, and the power spectrum. Signal-to-noise measurements indicate that reliable heterodyne communications are possible even under deep scintillation conditions.

TM X-64514 April 8, 1970

An Optical Image Comparator for Examination of Field Ion Micrographs. J. C. Gregory and I. Dalins. Space Sciences Laboratory.

This document is a description of a device that permits direct comparison of two complex recorded images or patterns. Any small differences between the two images, normally difficult to detect by visual inspection, are distinctly illuminated and readily noticed by the observer despite the mass of complex detail common to both images. The instrument was designed as an aid to single atom studies in the field ion microscope, but may also be of application in astronomy.

TM X-64516 April 15, 1970

Investigation of the Technical Micronics Control (TMC) Process for Electropolishing Various Metals. James R. Lowery. Astronautics Laboratory.

The Technical Micronics Control (TMC) process for electropolishing a variety of metals and metal alloys was investigated. The electropolishing solution produced lustrous surfaces on stainless steel, brass, copper, nickel, aluminum, and steel; it produced only semibright surfaces on Invar and René 41, but produced a considerable amount of metal smoothing. The passivation of stainless steel was improved

substantially by this method over that of conventional acid passivation methods. TMC polished surfaces of stainless steel, brass, and carbon steel did not accept an electroplate with good adherence but such surfaces were more resistant to tarnish or corrosion than mechanically polished surfaces. Based on results of this study, the TMC process is recommended for polishing and smoothing most metals and for passivating stainless steel.

TM X-64519 April 27, 1970

The Potential Temperature Profile in the Planetary Boundary Layer. George H. Fichtl and Julian F. Nelson. Aero-Astrodynamics Laboratory.

Nineteen observations of the temperature profile are used to analyze and to develop a model of the potential temperature profile $\overline{\theta}(z)$ in the planetary boundary layer. The observations consist of mean flow temperatures observed at the 3-, 18-, 30-, 60-, 120-, and 150-meter levels at the NASA meteorological tower site at Kennedy Space Center, Florida. It is provisionally concluded that the dimensionless potential temperature gradient $\phi_\theta = (z/T_{*o})\partial\overline{\theta}/\partial z$ is a function of z/L_o and $R_L = -fL_o/u_{*o}$, where T_{*o} and u_{*o} denote surface values of the friction temperature and friction velocity, L_o is the surface Monin-Obukhov stability length, and f is the Coriolis parameter. The expression $\phi_\theta = (1 - \gamma z/L_o)^{-1/2}$ summarizes the experimental results reasonably well, where γ is proportional to $R_L^{-3/2}$. The function ϕ_θ is integrated to yield the potential temperature profile and estimates of the potential temperature drop across the planetary boundary layer.

TM X-64522 May 18, 1970

Response Tests of Cup, Vane, and Propeller Wind Sensors. Dennis W. Camp, Robert E. Turner, and Luke P. Gilchrist. Aero-Astrodynamics Laboratory.

The results of a wind tunnel test program performed to investigate the response parameters of two types of cup anemometers, two types of wind vanes, and a propeller anemometer are presented. The distance constant for the cups (wind speed sensor) was found to be approximately 0.8 and 1.3 meters for the two types tested. Values for the damping ratio of approximately 0.48 and 0.40 were found for the two types of vanes. The main point of interest in the investigation of the propeller-type anemometer, other than its response, was how the indicated speed varied as a function of angle of attack. For an angle of attack (angle formed by the longitudinal axis of the anemometer and the wind flow direction) within ±30 degrees into or away from the flow direction, a cosine curve would give a good approximation to the data.

TM X-64523 May 20, 1970

RF Radiation Hazards to Space Station Personnel. R. A. Inman. Astrionics Laboratory.

Calculation of typical values of RF power density in the vicinity of space station antennas are included in this document. More definite calculations can be made when the system configurations have been more completely defined. However, the values calculated demonstrate that the currently accepted safe limits of RF radiation can be exceeded easily in the near field of high gain antennas on the space station. Personnel working in the field of these antennas should be protected from overexposure to this radiation.

TM X-64524 June 22, 1970

Radiation Degradation of Selected Films. William Oran. Space Sciences Laboratory.

The change in base fog caused by radiation damage was measured for the following film types: SO-180, EF 7241, EFB 7242, SO-246, SO-267, 2475, Plus-X, Tri-X, and 1N. The films were exposed to Co^{60} gamma rays in addition to 51.1- and 130.6-MeV protons. Graphs of density change versus radiation exposure are included in this report. Sensitometric curves are also given for SO-246, SO-267, 2475, 1N, Plus-X, and Tri-X films.

TM X-64526 June 8, 1970

Solar Indices for the Period January 1, 1955 Through December 31, 1969. H. C. Euler. Aero-Astrodynamics Laboratory.

This report lists solar-geomagnetic indices from January 1, 1955 through December 31, 1969 which may be used for model atmosphere studies. These tables contain daily sunspot number, solar 10.7-cm flux and the daily geomagnetic A_p index. Also included are the three-hourly K_p and a_p indices and 27-, 54-, and 81-day running means of sunspot numbers and solar flux.

TM X-64529 June 15, 1970

Table of Values of Integrals for the Longitudinal and Lateral von Karman Turbulence Spectra. Douglas D. Mackiernan. Aero-Astrodynamics Laboratory.

The longitudinal and lateral von Karman turbulence spectra are integrated over the domain $L\Omega_c < L\Omega < \infty$, where L is the integral scale of turbulence, Ω is a wave number and Ω_c is a cut-off wave number which defines the lower bound of integration. The integration procedure consists of expanding the spectra in Maclaurin series and integrating the resulting series term by term to yield tables of σ_u/σ and σ_w/σ as functions of $L\Omega_c$, where σ_u and σ_w are the contributions to the longitudinal and lateral deviations of turbulence from the Fourier components in the wave number domain $\Omega_c \leqq \Omega \leqq \infty$. The total longitudinal and lateral standard deviations are both equal to σ which is obtained by setting $\Omega_c = 0$. The tables provide values of σ_u/σ and σ_w/σ for $10^{-3} \leqq L\Omega_c \leqq 10^6$. A sample calculation is provided to aid the user.

TN D-5206 February 1970

Turbulence Measurements in Supersonic, Shock-Free Jets by the Optical Crossed-Beam Method. M. J. Fisher and K. D. Johnston. Aero-Astrodynamics Laboratory. N70-20577.

A new optical crossed-beam technique was used to measure the turbulence properties of two supersonic, shock-free, cold air jets. The method is based on the absorption of ultraviolet radiation by air. The measurements were highly successful in that reasonable and consistent values of the turbulence properties such as convection speeds, length scales, and spectra were obtained, and the data generally followed the trends set by hot-wire measurements in subsonic jets. The most interesting feature of the crossed-beam technique is the possibility of a direct measurement of three-dimensional spectral density. However, the demonstration that the crossed-beam technique can be used for turbulence measurements in supersonic flow is considered to be the major accomplishment.

TN D-5371 August 1969

Longitudinal Mass-Spring Modeling of Launch Vehicles. Rudolf F. Glaser. Astronautics Laboratory. N69-34970

To determine longitudinal axisymmetric vibration modes on launch vehicles, simplified models must be established. As a first step, a launch vehicle can be idealized by a chain of masses, helical springs, and liquid-filled containers. However, the realistic mass-spring representation of the liquid propellants supported by the elastic container wall is the problem. In this report, application of Galerkin's method to the equations of motion of the above simplified system is proposed, using the container-liquid modes with special normalization factors as coordinate functions. This method, identical with the Ritz method in this case, is favorable in several aspects. First, the resulting model is based on the energy law. The use of the container-liquid modes, however, results in accurate representation of significant structural and inertial characteristics of the container-liquid system. The special normalization of the coordinate functions converts the container-liquid systems directly in lumped parameter systems, having a number of degrees of freedom equal to the number of coordinate functions used. In this report, the containers are assumed cylindrical membranes with flat, rigid bottoms. For simplicity, typical tandem parts of vehicles, consisting of only one or two solid masses and springs and one liquid-filled container, are examined. If one-term approaches are considered, the resulting model can be interpreted as an actual spring-mass model. Because of the rapid decrease of the equivalent modal masses (with increasing mode number), restriction to one-term approaches does not mean considerable loss of accuracy. Comparison of analytical results with experiments provides satisfactory agreement. In this way, the use of large matrices in the final eigenvalue problem can be avoided.

TN D-5425 September 1969

Numerical Integration in a Rigid-Body Trajectory Program. John Edd Moore. Aero-Astrodynamics Laboratory. N69-38769.

A comparison is made of the fourth-order Runge-Kutta numerical integration technique with two numerical integration formulas in a mathematical model used for computing rigid body, first-stage trajectories of a Saturn space vehicle. The scope of the problem is to describe the mathematical model and to present a derivation of the differential equations of motion which it comprises; to establish a basis for comparing the integration techniques; and to generate sufficient comparison data to establish which integration technique is the most practical to use in this model from a standpoint of computer run time and accuracy. An analysis of the data showed a fourth-order formula to be the most practical integration technique to use in computer programs of this type from a standpoint of computation time, accuracy, and stability of the solution.

TN D-5426 October 1969

Rotating Space Station Stabilization Criteria for Artificial Gravity. Carl A. Larson. Astronautics Laboratory. N69-39210.

An understanding of man's dependency on a gravity field is an area where research has yielded limited results, thereby, prompting space station designers to include provisions for providing an

artificial gravity field capability. A rotogravic environment, though satisfying certain of man's physiological requirements, can introduce other complicated requirements. Therefore, this investigation was devoted to obtaining, for space station designers, insight into how man's physiological tolerances and range of adaptability can be used to define operational and configurational design criteria.

TN D-5439 October 1969

Final Report: Saturn V, S-IVB Panel Flutter Qualification Test. J. J. Nichols. Astronautics Laboratory. N69-38808.

This report gives results obtained from an evaluation of data taken during the Saturn S-IVB forward skirt flutter test conducted at Arnold Engineering Development Center, Tullahoma, Tennessee, during the period from October 30 through November 6, 1967. A fullscale segment of the S-IVB stage forward skirt was tested to determine the flutter characteristics of the thin skin panels bounded by internal rings and external stiffeners.

Since the skin panels were subjected to more severe flutter conditions than would be expected during flight, it is concluded that the S-IVB stage panel flutter is not critical for all Saturn IB and Saturn V published flight trajectories.

TN D-5469 November 1969

A Theoretical and Experimental Study of Unsteady Flow Processes in a Ludwieg Tube Wind Tunnel. John D. Warmbrod. Aero-Astrodynamics Laboratory. N70-10710.

The application of a numerical procedure generally referred to as the method of characteristics to calculate the nonsteady discharge of compressed air through a Ludwieg tube type of wind tunnel is presented. The mathematical model that underlies the numerical procedure assumes the flow through the wind tunnel to be time-dependent, one-dimensional, and compressible. The theoretical results presented were obtained from a computer program developed for this problem. Diaphragm rupture, variations in cross-sectional areas, contact surfaces, shock waves, and the interaction and reflection of contact surfaces and shock waves are included in the computer program. The theoretical results are compared with static and total pressures measured in a Ludwieg tube wind tunnel that has recently begun preliminary operation at MSFC. Good agreement between theory and experiment is achieved for the cases in which the flow in the test section was subsonic. Only fair agreement between the one-dimensional theory and experiment was achieved in the supersonic test sections. This difference is believed to be attributed to the two-dimensional character of the flow and the extensive flow separation that occurs in the supersonic nozzles during the early development of the flow.

TN D-5470 November 1969

Numerical Solution of Differential Equations Using Obrechkoff Corrector Formulas. Joseph S. Rosen. Computation Laboratory. N70-10685.

The solution of differential equations by predictor-corrector formulas which give high-order accuracy is considered. The corrector formulas are obtained from an extension of Obrechkoff's formula. These formulas are characterized by the fact that they contain higher derivatives of the unknown function $y(x)$, and if their derivatives are readily determinable, fewer terms are needed for a given order as compared to other multistep methods which do not involve derivatives. Corresponding to these corrector formulas, certain new predictor, or extrapolation, formulas are suggested. These formulas also make use of the derivatives used in the corrector formulas.

TN D-5517 December 1969

Flowmeter for Space. T. F. Morris. Quality and Reliability Assurance Laboratory. N70-12393.

This report discusses the development of a mass flowmeter designed for use in outer space. The purpose of the flowmeter is to measure flowrates from purges and collected leaks at leak ports, on aerospace hardware, discharging into a space environment. One of the most notable features of the flowmeter is the capability to measure the flow of all common gases, such as hydrogen, helium, nitrogen, oxygen, and organic vapors. These gases can be measured over a wide range of flowrates

(nitrogen, 5 to 2500 sccm) in a space environment of zero-gravity to extremely low pressures, and with temperature extremes of 70° to 500°K.

TN D-5584 February 1970

Longitudinal and Lateral Spectra of Turbulence in the Atmospheric Boundary Layer. George H. Fichtl and George E. McVehil. Aero-Astrodynamics Laboratory. N70-19272.

An engineering spectral model of turbulence is developed with horizontal wind observations obtained at the NASA 150-meter meteorological tower at Cape Kennedy, Florida. Spectra, measured at six levels, are collapsed at each level with Monin coordinates, where the longitudinal or lateral spectral energy density, the surface friction velocity, and the mean wind speed at some height are represented. A vertical collapse of the dimensionless spectra is produced by assuming they are shape invariant in the vertical. An analysis of the logarithmic spectrum in the inertial subrange, at the 18-meter level, implies that the local mechanical and buoyant production rates of turbulent kinetic energy are balanced by the local dissipation and energy flux divergence, respectively.

TN D-5633 February 1970

Shear Layer and Jet Instability in Stratified Media. George H. Fichtl. Aero-Astrodynamics Laboratory. N70-21619.

The stability to small perturbations of shear layer and jet flows in atmospheres with potential temperature is investigated. The problem is reduced to a characteristic value problem for the dimensionless wave frequency which appears in a second-order differential equation with the dependent variable being the horizontal and temporal Fourier transform amplitude of the vertical component of the perturbation momentum vector. Broken-line profiles of jet flow and potential temperature are used in the analysis of this problem.

Integral equations, over the domain of the fluid, which contain both quadratic forms and interfacial contributions, are derived. The interfacial terms vanish for continuous flows, and the theorems of Synge, Howard, and Miles follow. A necessary and sufficient condition for instability is also obtained for continuous flows; however, its usefulness is compromised by integrands which depend on both the basic state flow and the dependent variable of the governing differential equation.

TN D-5634 February 1970

Discontinuous Flows and Free Streamline Solutions for Axisymmetric Bodies at Zero and Small Angles of Attack. Heinz G. Struck. Aero-Astrodynamics Laboratory. N70-21527.

Except for a few numerical results, nothing has been published, comparable in magnitude to the two-dimensional case, concerning free streamline solutions of the axisymmetric problem. Since the method of using conformal transformations is not available in axisymmetric and three-dimensional flows, it is necessary to adopt approximate methods for the free streamline analysis. In this study an integral equation procedure has been applied to calculate the free streamline flow behind axisymmetric bodies at zero and small angles of attack. The method uses a modified condition for irrotational flow and iterates until the proper streamline location is found. Some of the results obtained by this procedure will be discussed in this report.

TN D-5687 March 1970

Effect of Wall Roughness on the Damping of Liquid Oscillations in Rectangular Tanks. Frank M. Bugg. Aero-Astrodynamics Laboratory. N70-20583.

An experimental investigation was made to determine the effectiveness of wall roughness for damping liquid oscillations in rectangular tanks. Roughness with height equal to 0.427 percent of the wetted wall area gave damping 65 percent greater than the smooth wall damping. Comparisons were made with viscous damping theory.

TN D-5714 March 1970

Stability of Constant-Gain Systems With Vector Feedback. George L. von Pragenau. Astrionics Laboratory. N70-21840.

Vector feedback is defined as a multivariable feedback loop that cannot be opened at a single nodal point. Such systems are treated for the constant-gain

(linear and time-invariant) case by decomposing such systems into stable subsystems. Ordinary algebraic operations always permit such decompositions. Relatively simple necessary and sufficient conditions result, and stability is analyzed for a closed-loop system in which the input is a disturbance vector and the output is a feedback vector. The proposed method permits a drastic reduction in the dimensions of a problem because of a building block approach. The state-space method is compared and found to be the limit case where the building block formulation assumes its maximum dimensions. Noncontrollable and nonobservable system parts are not nonconsequential because all subsystems are stable. The method presented was successfully used for the stability analysis of the Apollo-Saturn V pogo phenomenon where eigenvalues numbered well over a hundred. This problem was reduced to a single Nyquist plot analysis of a 4 by 4 determinant, demonstrating the power in reducing dimensions of a problem that would have been a formidable task for the state-space approach. The proposed method is generally applicable.

TN D-5722 April 1970

A Study of Radiation Heat Transfer From a Cylindrical Fin With Base Surface Interaction. Charles A. Cothran. Astronautics Laboratory. N70-24257.

This paper presents a study of the temperature distribution of a cylindrical fin transferring heat simultaneously by internal conduction and by surface radiation. The temperature distribution was studied considering the fin only and the more complex case of surface interactions with a circular base. Equations are derived for the temperature distribution of the fin only, the fin with base surface interactions when both surfaces are black, and also the case of gray diffuse surfaces. Solutions to the equations are obtained by numerical techniques, the analysis is verified experimentally, and the results are given.

TN D-5782 May 1970

A Finite Element Approach to the Structural Instability of Beam Columns, Frames, and Arches. Jerrell M. Thomas. Astronautics Laboratory.

A nonlinear stiffness matrix for a beam column element subjected to nodal forces and to a uniformly distributed load is developed from the principle of virtual displacements and the bifurcation theory of elastic stability. Three cases of applied load behavior are considered. The buckling load of a uniform circular arch is calculated as an example.

TN D-5808 June 1970

Nonlinear Fluid Oscillations in a Partially Filled Axisymmetric Container of General Shape. John Ray Admire. Astronautics Laboratory.

A solution for finite-amplitude free oscillations of fluid in a partially filled axisymmetric container is presented. The formulation of the problem resulted in a nonlinear boundary value problem where the nonlinearity occurred in the boundary condition at the free surface of the fluid. The boundary condition at the container wall and the differential equation are linear. The solution is obtained by first linearizing the free surface boundary condition and solving the resulting linear boundary value problem. Then, using the linear solutions, which satisfy the differential equation and the boundary condition at the container wall, a solution is found that satisfies the nonlinear boundary condition at the free surface asymptotically. A solution through the third-order term is developed. Numerical results are obtained for finite-amplitude standing waves near the first antisymmetric linear mode in three axisymmetric vessels. Results are found for three containers, a cylindrical tank with an ellipsoidal bulkhead, a cylindrical tank with a conical bulkhead, and a cylindrical tank with a truncated conical bulkhead.

TN D-5825 May 1970

Method for Calculating Rocket Engine Structural Loads. Jerrell M. Thomas. Astronautics Laboratory.

A method for calculating structural loads in a rocket engine-actuator-vehicle system is developed. The engine is attached to the vehicle by a universal-type gimbal joint and by two actuators. The engine is assumed to be a rigid body. Either the actuator loads or the engine angular acceleration is assumed to be known with a calculation of the other required. A set of algebraic equations is developed from which

the unknown actuator loads or angular acceleration and the forces and moments at the gimbal point can be calculated.

TN D-5841 June 1970

Leak Detector for Use in Space Environment. K. W. Woodis. Quality and Reliability Assurance Laboratory.

The design and manufacturing techniques and tests required to build a leak detector for aerospace hardware are presented. The basic configurations and power requirements are described in detail and the application of a leak detector to aerospace hardware is explained. The report shows that it is electronically, mechanically, and economically feasible to build leak detectors to support orbital inspection and checkout operations of large space stations and interplanetary vehicles.

TR R-315 July 1969

Low-Order Classical Runge-Kutta Formulas With Stepsize Control and Their Application to Some Heat Transfer Problems. Erwin Fehlberg. Computation Laboratory. N69-30753.

New first-, second-, third-, and fourth-order Runge-Kutta formulas with stepsize control procedures are derived. These new Runge-Kutta formulas have very small truncation errors; therefore, their application reduces computer time substantially. These low-order formulas are also applicable to parabolic partial differential equations as encountered in heat transfer problems. Examples for ordinary and partial differential equations are presented. In these examples the new formulas require only a fraction of the computer time of conventional formulas.

TR R-321 September 1969

Calibration of Pegasus and Explorer XXIII Detector Panels. Robert J. Naumann, David W. Jex, and Clyde L. Johnson. Space Sciences Laboratory. N69-36985.

Several series of tests were conducted to establish the ballistic limit for the various Pegasus and Explorer XXIII detector panels. In these tests, extremely small, carefully sized beads were launched in a velocity range that included the perforation threshold. By varying the size, a ballistic limit curve was established on a mass-velocity plot. Such curves were then extrapolated to average meteor velocity to obtain the characteristic mass for each sensor. Additional tests were conducted on the Pegasus panels using the Pegasus test tool, which contains the identical electronic circuitry used by the flight models. These tests included hot and cold tests, thermal cycling after impact, oblique impacts, etc. Several types of anomalous events noted in the operation of the spacecraft could be simulated in this manner. Some indication of the dependence of detection threshold upon size was obtained, and the implications of these tests in the analysis of the results will be discussed.

TR R-322 October 1969

Determination of Meteoroid Environments from Photographic Meteor Data. Charles C. Dalton. Aero-Astrodynamics Laboratory. N69-39336.

A mathematical model is used to represent Öpik's 1958 physical theory of meteors in a form convenient for programming the computation of meteoroid photometric mass values. Subsamples of 333 photographic meteors from McCrosky and Posen's sample are selected with respect to magnitude scaled for minimum velocity. A statistical comparison between the 1958 Öpik result and the 1933 Öpik provisional result, the Harvard-Meteor project basis for mass values, is given. Meteor and orbit parameter distributions and mean cumulative flux in absolute units for mass, momentum and energy are given separately for the terrestrial influx and for the lunar and interplanetary vehicle onfluxes.

TR R-335 April 1970

The One-Dimensional Time-Dependent Interaction of a Satellite with the Ionospheric Plasma. Nobie H. Stone and John W. Sheldon. Space Sciences Laboratory. N70-24381.

A theoretical study and numerical solution are presented for the one-dimensional, time-dependent problem of a streaming, nonuniform, fully ionized, collisionless plasma impinging upon a stationary, flat conducting plate oriented perpendicularly to the flow of the plasma. The problem is intended to model the interaction of the frontal surface of a satellite with the ionospheric plasma. The time-dependent equations that describe the one-dimensional problem are established, and from them the steady-state equations are derived. These steady-state equations are solved for the spatial dependence of the electric field, which is seen to be a reasonable form and to agree with previous work on more complicated configurations. Finally, a numerical method of solving the time-dependent equations is presented and applied to two special cases: (1) for a plate that has no initial charge, and (2) for a system that is initially in an equilibrium state and proceeds to a second equilibrium state because of a step transition in the plasma parameters.

CONTRACTOR REPORTS

(Abstracts for these reports may be obtained from STAR.)

CR-1410 August 1969

Investigation of the Turbulent Wind Field Below 150-Meter Altitude at the Eastern Test Range. NAS8-21140. Pennsylvania State University. N69-35570.

CR-1418 September 1969

Ground Wind Characteristics at Kennedy Space Center. NAS8-21178. Cornell Aeronautical Laboratory, Inc. N69-36222.

CR-1465 January 1970

Numerical Calculations of Viscous Compressible Fluid Flow Around a Stationary Cylinder. NAS8-18034. Applied Theory, Inc. N70-17371.

CR-1466 February 1970

Numerical Calculations of Viscous Compressible Fluid Flow Over a Flat Plate and Step Geometry. NAS8-11400. Applied Theory, Inc. N70-18252.

CR-1467 October 1969

Numerical Calculation of Viscous Compressible Fluid Flow Around an Oscillating Rigid Cylinder. NAS8-18034. Applied Theory, Inc. N69-38782.

CR-1529 May 1970

Vol. I. A Study of 30 km to 200 km Meteorological Rocket Sounding Systems: Parts 1 and 2. Literature and Data Review. NAS8-20797. Space Data Corp.

CR-61293 July 31, 1969

A Generalization of the Weibull Distribution. NAS8-11175. University of Georgia. N69-35624.

CR-61296 September 1969

STARLAB: An Orbiting Space Technology Applications and Research Laboratory. Final Report. NSR 01-003-025. Auburn University Engineering Systems Design Summer Faculty Fellows.

CR-61297 September 10, 1969

An Application of the Multivariate Extended Poisson Distribution in 2 Times 2 Contingency Tables. NAS8-11175. University of Georgia. N69-36015.

CR-61298 August 1969

A Preliminary Upper Atmospheric Density Model Derived From Satellite Drag Density Data. NAS8-30513. Lockheed Missiles and Space Co. N69-37255.

CR-61299 September 1969

Numerical Analysis of Shells, Volume I: Unsymmetric Analysis of Orthotropic Reinforced Shells of Revolution. NAS8-21113. Grumman Aircraft Engineering Corp. N70-12498.

CR-61300 September 1969

Numerical Analysis of Shells, Volume II: User's Manual for STARS-II — Shell Theory Automated for Rotational Structures-II-Digital Computer Program. NAS8-21113. Grumman Aircraft Engineering Corp. N70-12499.

CR-61301 September 1969

Numerical Analysis of Shells, Volume III: Engineer's Program Manual for STARS-II — Shell Theory Automated for Rotational Structures-II, Digital Computer Program. NAS8-21113. Grumman Aircraft Engineering Corp. N70-12500.

CR-61302 August 10, 1969

Sample Reduction Techniques for Minimizing Quantization Errors. NAS8-30518. Northrop Corp. N69-38181.

CR-61303 July 1969

Trajectories for the 1976-1980 Grand Tour Opportunities, Volume I: Graphic and Summary Trajectory Data. NAS8-20082. Lockheed Missiles and Space Co. N70-15089.

CR-61304 August 1969

Peak Wind Statistics Associated With Thunderstorms at Cape Kennedy, Florida. NAS8-20082. Lockheed Missiles and Space Co. N69-37958.

CR-61305 July 1969

Trajectories for the 1976-1980 Grand Tour Opportunities, Volume II, Trajectory Data. NAS8-20082. Lockheed Missiles and Space Co.

CR-61306 August 1969

Prediction of Geomagnetic Activity. NAS8-30156. McDonnell-Douglas Astronautics Co. N69-39662.

CR-61307 September 1969

Experimental Material Handling Device. Final Report. NAS8-30069. Martin-Marietta Corp.

CR-61308 September 1969

Cape Kennedy Peak Wind Profile Probabilities for Levels From 10 to 150 Meters. NAS8-20082. Lockheed Missiles and Space Co. N70-12204.

CR-61309 June 1969

Design and Development of Techniques for Fabrication of Cryogenic Tank Support Structures for Long Term Storage in Space Flights. NAS8-20901. The Boeing Co. N70-11342.

CR-61310 September 1969

Investigation of Brazed and Welded Connections. NAS8-20073. Brown Engineering Co. N70-11363.

CR-61311 October 1969

AS-507 H Mission Launch Vehicle Operational Trajectory for a December 1969 Launch. NAS8-20082. Northrop Corp.

CR-61312 January 1969

Static and Dynamic Calibrations of MSFC's Plug-Nozzle Special Test Section (Redesigned 1967). NAS8-20082. Nortronics. N70-11662.

CR-61313 July 1969

Evaluation of Odyssey-1 Orbital Aerodynamic Experiment Package. NAS8-20082. Northrop Corp. N70-15057.

CR-61314 September 1969

Computer Program for Crossed-Beam Studies of Clear Air Turbulence, Program Description (MLTCOR). NAS8-21300. IIT Research Inst. N70-12025.

CR-61315 September 1969

Bolt Installation and Removal Tool. NAS8-30026. Aerojet-General Corp.

CR-61316 October 1969

Long Range Solar Flare Prediction. NAS8-21436. Denver Research Inst. N70-14569.

CR-61317 January 7, 1970

Sphere Forming and Composite Casting in Zero-G. NAS8-21402. Arthur D. Little, Inc. N70-21873.

CR-61318 January 1970

Lidar Observations in Relation to the Atmospheric Winds. NAS8-21117. Stanford Research Inst. N70-20588.

CR-61319 February 1970

Surface Climatological Information for Twelve Selected Stations for Re-Entry Vehicles. Government Order H-76789. Environmental Science Services Administration.

CR-61320 January 1970

Laboratory Development of a Satellite Experiment for Gas-Surface Interaction Studies. NAS8-21450. University of Michigan.

CR-61321 November 1969

User's Manual for RAVFAC, a Radiation View Factor Digital Computer Program. NAS8-30154. Lockheed Missiles and Space Co.

CR-61322 May 1970

Range and Structure of Ambient Density From 30 to 120 km Altitude. NAS8-20098. GCA Corp.

CR-61323 January 1970

Analytical Study of Strain Rate Effects in Hypervelocity Impacts. NAS8-20235. Shock Hydrodynamics, Inc.

CR-61324 February 1970

A Statistical Sampling Procedure for Jimsphere Winds Aloft Population. NAS8-5608. The Boeing Co.

CR-61325 October 1969

Selecting Digital Filters for Application to Detailed Wind Profiles. NAS8-20082. Lockheed Missiles and Space Co.

CR-61326 April 1970

Handbook for Estimating Toxic Fuel Hazards. Final Report. NAS8-21453. GCA Corp.

CR-61327 April 1970

Analysis of Lower Atmospheric Data for Diffusion Studies. NAS8-30503. GCA Corp.

CR-61328 November 1969

Solid State Radiographic Image Amplifiers. Part B. NAS8-21206. Electronic Tube Div. of Westinghouse Electric Corp.

CR-61329 June 1970

Space Radiation Hazards To Project Skylab Photographic Film. NAS8-24514. Lockheed-Georgia Co.

CR-61408 September 27, 1968

Study of Indicial Aerodynamic Forces on Multistage Vehicle Systems. Volume 2: User's Manual for the Aerodynamics Computer Programs. NAS8-21167. Midwest Research Inst. N69-33449.

CR-61550 October 1, 1968

The Development of a Space Oriented Portable Work-Photographic Light in Support of S-IVB Spent Stage Experiments. NAS8-20679. Microdot, Inc. N69-35226.

CR-61635 June 1969

Operational Procedure for Determining Space Vehicle Response to Wind Turbulence. Volume 2: Appendixes. NAS8-21325. Martin Co. X69-18380.

CR-61796 October 1968

On the Synthesis of Suboptimal Inertia Wheel Control System. NAS8-18120. University of Texas.

CR-61797 December 31, 1968

An Investigation of Tandem Row High Head Pump Inducers. NAS8-20625. Hydronautics, Inc. X69-17682.

CR-61798 September 30, 1968

An Investigation of Tandem Row High Head Pump Inducers. NAS8-20625. Hydronautics, Inc.

CR-61828 September 1, 1968

Plasma Study. Radio Frequency Systems. Millimeter Waves Study. NAS8-11184. Auburn University. N69-35151.

CR-61885 December 1, 1968

Millimeter Waves Study. Radio Frequency System. NAS8-11184. Auburn University. N69-35255.

CR-61895 June 1969

Operational Procedure for Determining Space Vehicle Response to Wind Turbulence. Vol. 1. NAS8-21325. Martin Co. X69-18379.

CR-61928 September 27, 1968

Study of Indicial Aerodynamic Forces of Multistage Space Vehicle Systems. Volume I: Application of Theory to Basic Geometries and to the Saturn V. NAS8-21167. Midwest Research Inst. N69-33448.

CR-61945 August 1968

Establishment of Standards for Compatibility of Printed Circuit and Component Lead Materials. Final Report. NAS8-20390. Martin Marietta Corp. X69-17675.

CR-61953 June 30, 1968

Effects of Radiation on the Friction and Wear of Kynar. Final Report. NAS8-20961. Hughes Aircraft Co. X69-17631.

CR-98031 October 11, 1968

The Effects of Hydrogen on Unprotected Titanium Alloy Weldments. QPR-1. NAS8-21470. McDonnell-Douglas Astronautics Co. X69-17653.

CR-98036 August 20, 1968

Study for Passive Gravity Stabilization. Final Technical Report. NAS8-21177. General Electric Co. N69-35262.

CR-98037 December 1968

Development of Multilayer Epitaxy for High Reliability Transistors. Interim Summary Report. Mod. 2. NAS8-18125. Westinghouse Electric Corp. N69-34377.

CR-98096 January 15, 1969

Study of Crack Initiation Phenomena Associated With Stress Corrosion of Aluminum Alloys. NAS8-20396. Alcoa Research Lab.

CR-98106 January 6, 1969

Activated (WET) Stand Life Zinc-Oxygen Cells. NAS8-20565. Leesona Moos Lab.

CR-98115 January 19, 1969

Development of Vulcanizable Elastomers for Use in Contact With Liquid Oxygen. NAS8-5352. Peninsular Chemresearch.

CR-98118 January 31, 1969

Development of Improved Structural Adhesive. Second Annual Summary Report. NAS8-20406. Monsanto Research Corp.

CR-98122 November 15, 1968

The Development of Structural Adhesive Systems Suitable for Use With Liquid Oxygen. NAS8-11068. Whittaker Corp. X69-17658.

CONTRACTOR REPORTS

CR-98143 November 27, 1968

Research Study on Instrument Unit Thermal Conditioning Panels. NAS8-11291. Airesearch Mfg. Co. X70-10650.

CR-98150

Holographic Interferometric Analysis of Panel Vibrating Characteristics. NAS8-21369. GC Optronics, Inc. X69-17626.

CR-98201 June 8, 1968

Saturn V AS-503 D Launch Vehicle Flight System Dispersion Analysis (U). Final Report. CONFIDENTIAL. NAS8-5608. The Boeing Co.

CR-98243 August 31, 1968

Sound Wave Shear Wave Interaction With Oblique Shock Fronts. NRG15-005-056. Purdue University. N69-36011.

CR-98281 March 1969

Digital Computation of Downstream Modes Generated by the Interaction of a Shock Wave With an Upstream Flow Containing the Three Disturbance Modes. NAS8-21100. Wyle Labs, Inc.

CR-98291 December 1968

Development of Materials and Materials Application Concepts for Joint Use as Cryogenic Insulation and Micrometeoroid Bumpers. Quarterly Progress Report 3. NAS8-30140. Goodyear Aerospace Corp.

CR-98323 October 1, 1969

Saturn V AS-504 D Mission Launch Vehicle Flight System Dispersion Analysis. CONFIDENTIAL. NAS8-5608. The Boeing Co.

CR-98331 October 1, 1968

Technical Manual — Stage System Description S-1C-3-4-5. NAS8-5608. The Boeing Co.

CR-98332 November 1968

Dynamic Response of a Double Squeeze-Film Thrust Plate. NAS8-11678. Mechanical Technology, Inc. N69-34747.

CR-98333 August 7, 1969

Advanced Engine Aerospike Experimental Program Thrust Chamber Performance. (U) Volume I CONFIDENTIAL. North American Rockwell Corp.

CR-98395 August 8, 1969

Suppression of Combustion Oscillations With Mechanical Damping Devices. Interim Report. NAS8-21310. Pratt & Whitney Aircraft.

CR-98470 August 14, 1968

Apollo Applications Program (AAP) Payload Integration Design Reference Mission, Document Mission AAP-1.AAP-2 Volume I — Mission Description. NAS8-24000. Martin Marietta Corp.

CR-98471 August 14, 1968

Apollo Applications Program (AAP) Payload Integration Design Reference Mission, Document Mission AAP-1.AAP-2 Volume II — Detailed Orbit Trajectory. NAS8-24000. Martin Marietta Corp.

CR-98472 May 28, 1969

Some Relationships Between Random and Non-Random Expectancies. NAS8-18405. Computer Sciences Corp. N69-28315.

CR-98473 January 1969

Radiation Effects on Composite Structures. NAS8-21050. Lockheed-Georgia Co. N69-28424.

CR-98474 December 15, 1968

Development of Quality Assurance Requirements for Planetary Spacecraft To Be Sterilized by Heating. Final Report. NAS8-21139. General Electric Co. X69-16142.

CR-98475 August 1968

Analysis of Potential Community Response to Test Operations of Rocketdyne/Santa Susana Facility. NAS8-21260. Wyle Labs, Inc. N69-28485.

CR-98476 August 1968

Estimate of Nuclear Technology Engine Test Stand Sound Power and Spectrum. NAS8-21260. Wyle Labs, Inc. N69-28850.

CR-98477 August 1968

Test Plan for MARL Experimental Shroud Test Program. NAS8-21260. Wyle Labs, Inc. N69-28858.

CR-98479 May 1968

Use of Scale Models To Determine the Structural Dynamic Characteristics of Space Vehicles. NAS8-21456. Martin Marietta Corp. N69-29373.

CR-98480 March 4, 1969

Development of Lubricating Oils Suitable for Use With Liquid Oxidizers. Final Report. NAS8-21269. Midwest Research Inst. N69-29706.

CR-98481 February 14, 1969

Propulsion Simulation Module Accuracy Study. NAS8-21467. Operations Research, Inc. X69-16391.

CR-98482 November 1968

Generalized Gaseous Discharge Characteristics of Flat Plate Orifices. NAS8-20200. Northrop Corp. X69-16119.

CR-98483 October 1968

Digital Cryogenic Thermometer. NAS8-20606. Trans-Sonics, Inc. X69-16384.

CR-98484 July 28, 1968

The Study of Infrared Evaluation in Qualification and Failure Analysis of Semiconductor Devices. NAS8-21219. Philco Corp. N69-29912.

CR-98485 December 15, 1968

Generalized Quasi-Linearization Routines for Solving Nonlinear Boundary-Value Problems. NAS8-20238. North American Rockwell Corp. N69-29793.

CR-98486 July 22, 1968

Portable Prototype Tube Flare Inspection Instrument. Final Report. NAS8-20516. Metrophysics, Inc. X69-16780.

CR-98487 May 31, 1969

Behavior of Nozzles and Acoustic Liners in Three-Dimensional Acoustic Fields. Georgia Inst. of Tech. NGR-11-002-085. N69-30293.

CR-98488 March 24, 1969

Investigation of Methods for Transportation Cooling Liquid Rocket Chambers. NAS8-21135. Pratt & Whitney Aircraft.

CR-98489 January 16, 1969

Design and Development of Techniques for Fabrication of Cryogenic Tank Support Structures for Long Term Storage in Space Flights. Phase I. NAS8-20901. The Boeing Co. N69-29584.

CONTRACTOR REPORTS

CR-98490 April 1969

Advanced Studies of Stochastic Processes: Estimation of Power Spectra From Non-stationary Flight Data. NAS8-21370. Research Triangle Inst. X69-16387.

CR-98491 May 22, 1969

An Analytical and Experimental Development Program for Inflatable Solar Shields. Volume I: Program Summary, Results, and Conclusions. NAS8-21132. General Dynamics. X69-16584.

CR-98492 April 1969

Prediction of Smoothed Sunspot Number Using Dynamics Relations Between the Sun and Planets. NAS8-21445. Lockheed Missiles and Space Co. N69-29781.

CR-98495 July 18, 1969

AS-205/CSM-101 Flight Mechanical Failure Effects of Thrust Loss in Two Engines. NAS8-4016. Chrysler Corp. X69-16379.

CR-98496 1968

Metallurgical Analysis of Engine Actuator Midstroke Locking Mechanism Bolts, MS 24678-60. NAS8-5608. The Boeing Co. N69-32640.

CR-98497 March 31, 1969

Processing Application and Evaluation of Sealants for Fuel Tanks in Advanced Space Structures. NAS8-21399. Monsanto Research Corp.

CR-98498 December 31, 1968

Digital Data Sampling Modules. Quarterly Progress Report. NAS8-30003. General Instrument Corp. X69-16378.

CR-98499 February 28, 1968

Investigation of Electro-Optical Techniques for Controlling the Direction of a Laser Beam. Interim Report. NAS8-11459. General Telephone and Electronics Lab, Inc. X69-16348.

CR-102201 December 1968

Spin Axis Bearing Improvement Program. NAS8-11356. Bendix Corp. X69-16452.

CR-102202 March 31, 1969

Thermally Resistant Polymers for Fuel Tank Sealants. NAS8-21401. Monsanto Research Corp.

CR-102203 April 15, 1969

Development of Space-Stable Thermal-Control Coatings. NAS8-5379. IIT Research Inst. N69-29596.

CR-102204 February 28, 1969

A Study of the Mechanism of Chemical Reactivity of Nitrogen Tetroxide With Titanium Alloys. Final Report. NAS8-21207. Hercules Research Center. N69-31340.

CR-102205 December 6, 1968

Minimum Pressure Loss in High Velocity Flow Duct Systems. NAS8-21133. Southwest Research Inst.

CR-102206 April 1969

Application of Integral Damping for Duct Assembly Vibration Suppression. Final Report. NAS8-21128. Solar Div. of International Harvester Co. N69-31490.

CR-102207 February 1968

Reducing Quantizer Deadband With a Range Switching Digital Filter. NAS8-11274. Auburn University. N69-31293.

CR-102208 October 21, 1969

Research Study on Instrument Unit Thermal Conditioning Panels. Second Quarterly Progress Report. NAS8-11291. Airesearch Mfg. Div. X69-16888.

CR-102209 December 1968

Advanced Engine Aerospike Experimental Investigation Performance Program. Monthly Status Report. NAS8-20349. Rocketdyne Div. of North American Rockwell Corp.

CR-102210 November 1968

EBW Firing Unit-Detonator Compatibility Test. NAS8-20404. Franklin Inst. Research Lab. X69-16842.

CR-102215 December 12, 1968

Evaluation of Cryogenic Insulation Materials and Composites for Use in Nuclear Radiation Environments: Materials Test and Propellant Heating Test. NAS8-18024. General Dynamics. X69-16870.

CR-102216 January 15, 1968

Development of Space-Stable Thermal-Control Coatings. NAS8-5379. ITT Research Inst. N69-31335.

CR-102218 April 22, 1968

Bibliography on Techniques for Solving Partial Differential Equations by Hybrid Computation and Other Methods. NAS8-2473. Georgia Inst. of Tech. N69-31385.

CR-102219 January 15, 1968

Hydrogen Reliquefier. Quarterly Report. NAS8-21203. Air Products and Chemicals, Inc. N69-31489.

CR-102220 July 15, 1968

Inner Loop Integrator Feasibility Study. NAS8-20730. Hydraulic Research and Mfg. Co. N69-31365.

CR-102223 May 27, 1968

Math Models for NASA/Huntsville Strapdown System Tests. NAS8-21366. Dynamics Research Corp. N69-32375.

CR-102224

Development of Saturn Manufacturing Technology for Welding Methods and Techniques. NAS8-21174. Harvey Aluminum Co.

CR-102227 March 1968

Solder Study Conducted on Apollo Telescope Mount Gyro Processor. (Group 1 and 2 Tests). Final Report. NAS8-11684. Martin Co., Orlando. N69-36267.

CR-102228 September 1968

Development of Vulcanizable Elastomers Suitable for Use in Contact With Liquid Oxygen. NAS8-5352. Peninsular Chem-Research, Inc. N69-36193.

CR-102229 January 31, 1969

Development of Improved Structural Adhesives. NAS8-20406. Monsanto Research Corp. N69-36234.

CR-102230

A Study of Entry Heating to a Probe Entering the Atmospheres of Jupiter. NAS8-21022. Lockheed Missiles and Space Co. X69-18024.

CR-102232 June 2, 1969

Influence of a Rigid Top Mass on the Response of a Pressurized Cylinder Containing Liquid Part I. NAS8-21282. Southwest Research Inst. N69-36426.

CR-102233 June 2, 1969

Dynamic Stability of Cylindrical Propellant Tanks-Final Report. Part 2. NAS8-21282. Southwest Research Inst. N69-36427.

CR-102234 August 1969

Optimum Rendezvous Guidance Study. Final Report. NAS8-21146. Lockheed Missiles and Space Co. N69-36368.

CR-102236 August 1969

Study of High Altitude Plume Impingement: Program User's Manual. Final Report. NAS8-21463. Lockheed Missiles and Space Co. X69-18693.

CR-102237 June 1969

Spacecraft Attitude, Stabilization, and Control Systems: Computer Program User's Manual. NAS8-21466. Martin Marietta Corp. X69-19046.

CR-102238 April 23, 1969

Study on an Electrostatic Zero-Gravity Work Bench Prototype. Final Report. Phase 1. NAS8-21385. Chrysler Corp. N69-37369.

CR-102239 March 7, 1969

Study of In Situ Degradation of Thermal Control Surfaces. Interim Summary Report. NAS8-21074. ITT Research Inst. N69-37456.

CR-102240 April 1968

ATM Optical Contamination Study: Reaction Control System Rocket Engine Space Plume Flow Fields. Teledyne, Inc. N69-37277.

CR-102241 August 1969

Preliminary Upper Atmospheric Density Model Derived From Satellite Drag Density Data. Final Report. NAS8-30513. Lockheed Missiles and Space Co.

CR-102242 March 14, 1969

Revised Launch Vehicle Cost Model — Technical Report. Vol. I NAS8-21437. General Dynamics. X69-19054.

CR-102243 September 11, 1968

Demonstration of Manufacturing Techniques for Application of High Performance Cryogenic Insulation. Final Report. NAS8-21341. The Boeing Co. N69-37299.

CR-102244 June 30, 1969

Digital Data Sampling Modules. NAS8-30003. General Instrument Corp.

CR-102245

Solution of Systems of Nonlinear Equations. Final Report. NAS8-21484. Tulane University. N69-37349.

CR-102246 May 16, 1969

Investigation of Reactivity of Launch Vehicle Materials With Liquid Oxygen. NAS8-21316. Stanford Research Inst. N69-37416.

CR-102247 June 1968

Mission Oriented Study of Advanced Nuclear System Parameters. Final Report. Phase VI. Vol. I. NAS8-5371. TRW Systems Group. N69-37572.

CR-102248 June 1968

Mission Oriented Study of Advanced Nuclear System Parameters. Final Report. Phase VI. Vol. II. NAS8-5371. TRW Systems Group. N69-37573.

CR-102249 July 20, 1969

Low Gravity Propellant Control Using Capillary Devices in Large Scale Cryogenic Vehicles. Fourth Quarterly Report. NAS8-21465. General Dynamics. X69-18936.

CR-102250

Safe Operating Area Determination for Prevention of Second Breakdown. NAS8-21155. Bendix Corp. N69-37780.

CR-102251 July 1969

Dynamic Docking Study Final Report — Appendix B. NAS8-30515. Lockheed Missiles and Space Co. X69-19032.

CR-102252 March 14, 1969

Revised Launch Vehicle Cost Model. Technical Report. Vol. 2. NAS8-21437. General Dynamics. X69-19055.

CR-102253 March 14, 1969

Revised Launch Vehicle Cost Model. Technical Report. Vol. 3. NAS8-21437. General Dynamics. X69-19056.

CR-102254 November 1968

Results of an Experimental Investigation To Obtain Surface Pressure Distributions on Four Models: Two Variable Cross Sections of Two Different Scales. Vol. 4. NAS8-20786. Chrysler Corp. X69-18833.

CR-102255 November 1968

Results of an Experimental Investigation To Obtain Surface Pressure Distributions on Four Models: Two Variable Cross Sections of Two Different Scales. Vol. 3. NAS8-20786. Chrysler Corp. X69-18832.

CR-102257 November 1968

Results of an Experimental Investigation To Obtain Surface Pressure Distributions on Four Models: Two Variable Cross Sections of Two Different Scales. Vol. 2. NAS8-20786. Chrysler Corp. X69-18831.

CR-102258 November 1968

Results of an Experimental Investigation To Obtain Surface Pressure Distributions on Four Models: Two Variable Cross Sections of Two Different Scales. Vol. 1. NAS8-20786. Chrysler Corp. X69-19077.

CR-102259 December 27, 1968

The Development of Structural Adhesive Systems Suitable for Use With Liquid Oxygen. NAS8-11068. Whittaker Corp. N69-40782.

CR-102260 September 30, 1968

Man/System Integration Specialized Analysis. QPR-1. NAS8-21455. Matrix Corp. X69-19686.

CR-102262

Group 1 Test Report — Solder Study Conducted on Apollo Telescope Mount Gyro Processor. NAS8-11684. Martin Marietta Corp.

CR-102264 March 1969

Acoustic Liners for Large Engines. Final Report. NAS8-21345. Rocketdyne Div. of North American Aviation Corp. X69-19464.

CR-102265 June 25, 1969

Man/System Integration Specialized Analysis. Final Report. NAS8-21455. Matrix Corp. X69-19463.

CR-102266 April 1969

Development of Advanced Materials for Integrated Tank Insulation System for the Long Term Storage of Cryogens in Space. NAS8-21330. Martin Marietta Corp.

CR-102267 August 31, 1969

Dynamic Analysis of Stability and Deployment of Inflatable Shell Structures. Final Report. NAS8-21480. University of Alabama. N69-39918.

CR-102268 May 1969

Space Thermal Control by Freezing and Melting — Space Thermal Control Study. NAS8-21123. Lockheed Missiles and Space Co. N69-40104.

CR-102269 June 1969

Characteristics of the Static and Fluctuating Pressure Environments Induced by Three-Dimensional Protuberances at Transonic Mach Numbers. NAS8-21026. Wyle Labs, Inc. N69-40127.

CR-102272 August 1969

Use of Dynamic Scale Models To Determine Launch Characteristics. Final Report. Vol. I. NAS8-21101. Martin Marietta Corp. N69-41164.

CR-102273 March 1969

Investigation and Improvement in the Moderate Depth Lunar Drill. NAS8-20845. Westinghouse Electric Corp. X69-19845.

CR-102274 September 15, 1969

Saturn V Derivative (S-1C/S-IVB/1U) Launch Vehicle System Study. Vol. 2: Appendices. NAS8-30506. The Boeing Co. X69-19504.

CR-102275 July 15, 1968

Advanced Engine Aerospike Experimental Program. Interim Report — July 1, 1967 to May 31, 1968 (U) CONFIDENTIAL. NAS8-20349. North American Rockwell Corp.

CR-102277 January 1968

Development and Test of a Sterile Insertion Technique. Final Technical Report. NAS8-21122. Martin Marietta Corp. X69-19601.

CR-102278 April 30, 1969

J-2 Program. Quarterly Progress Report — January to March 1969. NAS8-19. Rocketdyne Div. of North American Rockwell Corp. X69-19602.

CR-102279 September 1969

Experimental Material Handling Device. Final Report. NAS8-30069. Martin Marietta Corp. N69-40938.

CR-102280 August 1969

Use of Dynamic Scale Models To Determine Launch Vehicle Characteristics. Final Report. Vol. 2. Experimental Investigation. NAS8-21101. Martin Marietta Corp. N69-41165.

CR-102281 February 2, 1968

Saturn V S-IC Final Propulsion System Performance Prediction — Flight SA-503. Vol. I. NAS8-5608. The Boeing Co.

CR-102282 July 15, 1968

S-II/503 and S-IVB/503 Final Propulsion System Performance Prediction Update for the SA-503 Manned Mission, SSR-207. Vol. II. NAS8-5608. The Boeing Co.

CR-102283 July 15, 1968

Saturn V S-IVB Final Propulsion System Performance Prediction Flight SA-503. Vol. III. NAS8-5608. The Boeing Co.

CR-102284 August 11, 1969

Launch Vehicle Trajectory Optimization Computer Program (Phase IV). Technical Progress Report. NAS8-30509. Northrop Corp. X69-19842.

CR-102286 April 15, 1969

Saturn V Launch Vehicle Flight Dynamics Analysis AS-505. NAS8-5608. The Boeing Co.

CR-102287 May 1969

Noise Reduction Study of Orbiting Workshop Ventilation Fans. NAS8-21260. Wyle Labs, Inc. N70-10329.

CONTRACTOR REPORTS

CR-102288 May 1969

A Multivariate Interpolation Technique To Produce Three Dimensional Surface Plots of Vibrating Structures. NAS8-21260. Wyle Labs, Inc. N70-10328.

CR-102289 May 1969

Preliminary Criteria for Internal Acoustic Environments of Orbiting Space Stations. NAS8-21260. Wyle Labs, Inc. N70-10242.

CR-102290 August 1969

A Study of Programs for Evaluation of Component Life. Final Report. NAS8-21296. Martin Marietta Corp. X69-19887.

CR-102291 March 1, 1968

Probability of EOSS Mission Survival Evaluation of the Impact of Artificial-Gravity Operations on the Overall Mission Reliability. NAS8-20412. Federal Electric Corp. N70-10029.

CR-102292 April 15, 1968

Study of Cryogenic Propellant Stratification Reduction Techniques. NAS8-20330. General Dynamics.

CR-102293 May 1968

Development of Barrier-Layer Anodized Aluminum for Spacecraft Thermal Control. NAS8-21195. The Boeing Co. X69-19798.

CR-102294

Development of a Micrometeoroid Simulation Device. Vol. I. NAS8-20529. Bendix Corp.

CR-102295

Development of a Micrometeoroid Simulation Device, Constant Area Accelerator. Vol. II. NAS8-20529. Bendix Corp.

CR-102296 July 15, 1969

Response of a Cylindrical Shell to Random Acoustic Excitation. Interim Report. NAS8-21479. Southwest Research Inst. N70-13277.

CR-102297 October 15, 1968

A Model for Human Controller Remnant. NAS8-21136. Bolt, Beranek, and Newman, Inc. N70-11443.

CR-102299 May 1968

Solid State Radiographic Image Amplifiers. Final Report. Phase A. NAS8-21206. Westinghouse Electric Corp. N70-11281.

CR-102300 April 1969

Qualitative and Quantitative Evaluation of Factors Producing High Efficiency Welds With an Out-of-Vacuum Electron Beam Welder. NAS8-11929. Westinghouse Electric Corp., Astronuclear Lab.

CR-102301 June 12, 1969

Study of Gas-Tungsten-Arc Welding Power Density. Final Report. NAS8-21373. Lockheed Missiles and Space Co. N70-11448.

CR-102302 May 1969

Computer Generation of Television Images: Real-Time Simulation of Lunar Landscape Displays. NAS8-21367. Pennsylvania Research Associates, Inc. N70-11235.

CR-102303

A Study of the Effects of Varying the Sampling for a Simplified Version of the Saturn V/S-1C. NAS8-21377. Mississippi State University. N70-11180.

CONTRACTOR REPORTS

CR-102304 April 20, 1969

Low Gravity Propellant Control Using Capillary Devices in Large Scale Cryogenic Vehicles. QPR-3. NAS8-21465. General Dynamics. X70-10354.

CR-102305 November 15, 1968

Updated Emergency Detection System Analysis of Upper State Malfunctions for the AS-503 C Mission. NAS8-5608. The Boeing Co.

CR-102306 October 6, 1969

Apollo Saturn V Postflight Trajectory AS-506. NAS8-5608. The Boeing Co.

CR-102308 May 1969

Experimental Investigation of Capillary Propellant Control Devices for Low Gravity Environments. NAS8-21259. Martin Marietta Corp. X70-10337.

CR-102310 March 1969

The Application of Holography to Structural Analysis: A Review of the State-of-the-Art and Certain Preliminary Experimental Results. NAS8-21260. Wyle Labs, Inc. X70-10332.

CR-102311 March 1969

Development of Materials and Materials Application Concepts for Joint Use as Cryogenic Insulation and Micrometeoroid Bumpers. Quarterly Progress Report No. 6. NAS8-30140. Goodyear Aerospace Corp. X70-10353.

CR-102312 January 16, 1969

Saturn V Derivative (S-IC/S-IVB) Launch Vehicle System Study. Phase I Report. NAS8-30506. The Boeing Co. X70-10107.

CR-102313 June 1969

Nitrogen Tetroxide Flow Decay Study for the Orbital Workshop Propulsion System. NAS8-21489. TRW Systems Group. N70-10973.

CR-102314 May 1969

Dual-Mode (Manned/Automated) Lunar Roving Vehicle — Design Definition Study. First Monthly Program Progress Review. NAS8-24528. Aerospace Systems Division of Bendix Corp.

CR-102318 May 22, 1969

Determination of the Wind Response of AS-504 by Statistical Methods. NAS8-21314. General Electric Co. X70-10333.

CR-102319 September 12, 1969

Super Insulation Systems for Cryogenic Test Tank. Final Report. NAS8-11740 and NAS8-24567. Union Carbide Corp. N70-10902.

CR-102320 March 14, 1969

Turnaround Time Study: Revised Launch Vehicle Cost Model. NAS8-21437. General Dynamics. X70-10336.

CR-102321 March 3, 1969

Function Generator Prototype Circuits. Final Report. NAS8-30032. Motorola, Inc. N70-11505.

CR-102322 April 16, 1969

Nonisentropic Finite-Amplitude Wave Generation. Final Report. NAS8-21406. North American Rockwell Corp.

CR-102323 March 1968

Development of Materials and Materials Application Concepts for Joint Use as Cryogenic Insulation and Micrometeoroid Bumpers. NAS8-11747. Goodyear Aerospace Corp. X70-10182.

CR-102325 December 31, 1968

Processing Application and Evaluation of Sealants for Fuel Tanks in Advanced Space Structures. NAS8-21399. Monsanto Research Corp.

CR-102326

Suppression of Combustion Oscillations With Mechanical Damping Devices. QPR-3. NAS8-21310. Pratt & Whitney Aircraft.

CR-102327

Heat Rejection Systems for Electrochemical Equipment. Phase I - Final Report. NAS8-102328. General Electric Co.

CR-102328 April 30, 1969

Study of a Water Electrolysis System To Support an Intermediate Size Lunar Mission. Second Phase Technical Summary Report. NAS8-21190. Chrysler Corp. X70-10653.

CR-102329 November 1969

Lidar Observations in Relation to the Atmospheric Winds Aloft. NAS8-21117. Stanford Research Inst. N70-20588.

CR-102330 March 13, 1968

Plan for a Wind Tunnel Test To Survey the Flow About an Ogive-Cylinder - Frustum-Cylinder Model at 1.96 Mach Number. NAS8-20786. Chrysler Corp. X70-10819.

CR-102337

Ranking and Selection of Insulation Systems for MNV Application. Special Report No. 1: Investigation of High-Performance Insulation Application Problems. NAS-21400. McDonnell-Douglas Astronautics Co. N70-12838.

CR-102338

Evaluation of Methods for Computing Nuclear Rocket Radiation Field. NAS8-9500. Lockheed-Georgia Co., Nuclear Lab N70-12633.

CR-102339 May 16, 1969

Continuation of the Development of a Typical Mars Landing Capsule Sterilization Container. Final Report. NAS8-20682. Avco Corp. N70-12549.

CR-102340 May 12, 1969

Study of the Behavior of High Speed Angular-Contact Ball Bearings Under Dynamic Load. Final Report. NAS8-21255. Battelle Memorial Inst.

CR-102341

Operating Tests of the H-1 Engine Hydraulic System and Components Under Known Conditions of Fluid Contamination. Final Report. NAS8-1534. Franklin Inst.

CR-102343 November 30, 1968

Study of the General Mechanism of Stress Corrosion of Aluminum Alloys and Development of Techniques for Its Detection. QR-8. NAS8-20297. Tyco Labs, Inc. N70-12931.

CR-102345 March 1969

Saturated System Behavior: Surface Boiling and Controlled Blowdown. Final Report. NAS8-11234. Auburn University. N70-12931.

CR-102346 April 1969

An Investigation Study on Model Reference Adaptive Techniques As Applied to Attitude Control System for Launch Vehicles. NAS8-21019. University of California. N70-12610.

CR-102347 March 1969

Materials Studies Related to Lunar Surface Exploration. Vol. 3. Final Report. NSR-05-003-189. University of California. N70-12574.

CR-102349 February 20, 1969

Lunar Surface Engineering Properties Experiment Definition. NAS8-21432. University of California. N70-12551.

CR-102350 June 17, 1968

Research Study for Determination of Liquid Surface Profile in a Cryogenic Tank During Gas Injection. Annual Report. NAS8-11334. Mississippi State University. N70-12495.

CR-102351 January 14, 1969

Analysis of Atmospherically Induced Errors in an Optical Tracking System. University of Alabama. N70-12605.

CR-102352 April 15, 1969

Analytical and Experimental Development Program for Inflatable Solar Shield. NAS8-21132. General Dynamics. N70-12597.

CR-102353 May 16, 1969

Continuation of the Development of a Typical Mars Landing Capsule Sterilization Container. NAS8-20682. Avco Corp. N70-12664.

CR-102355 April 1969

Control System Optimization for Saturn V Launch Vehicles Using Gradient Techniques. Final Report. NAS8-30515. Lockheed Missiles and Space Co. X70-10639.

CR-102356 May 15, 1968

Development of Improved Semi-Organic Structural Adhesives for Elevated Temperature Applications. NAS8-11371. Monsanto Research Corp. N70-12456.

CR-102358 February 1969

Evaluation of Cryogenic Insulation Materials and Composites for Use in Nuclear Radiation Environments: Materials Test and Propellant Heating Test. Quarterly Progress Report. NAS8-18024. General Dynamics. X70-10651.

CR-102359 November 1968

Remote Sensing in the Infrared From Lunar Orbit. NAS8-20166. Teledyne Co. X70-10546.

CR-102360 October 1968

A Digital Technique To Compensate for Time-Base Error in Magnetic Tape Recording. NAS8-20172. University of Alabama. N70-12475.

CR-102361 April 1969

Low-Gravity Fuel Sloshing in an Arbitary Axisymmetric Rigid Tank. NAS8-20290. Southwest Research Inst. N70-12476.

CR-102363 February 1969

Studies in Theory and Application of Kalman Filtering. Final Technical Report. NAS8-21289. Univac Div. of Sperry Rand Corp. X70-10557.

CR-102364 May 15, 1969

Study of Structural-Thermal Insulation-Meteoroid Protection Integration. NAS8-21430. The Boeing Co. N70-12537.

CR-102365 July 1969

Preparation of Pigments for Space-Stable Thermal Control Coatings. NAS8-21317. Ohio State University Research Foundation. N70-12310.

CR-102367

Guidance System Error Study Program Statistical Measure of Performance. NAS8-11381. Lockheed Missiles and Space Co.

CR-102368

Computer Programs for the Calculation of Direct and Cross Power Spectral Density of Discrete Random Data. NAS8-21060. Wyle Labs, Inc. N70-12516.

CR-102369

Estimation of Direct and Cross Power Spectral Density of Discrete Data Using the Fast Fourier Transform. NAS8-21026. Wyle Labs, Inc. N70-12524.

CR-102370 April 1969

Spectral Techniques in Jet Noise Theory. NAS8-21060. Wyle Labs, Inc. N70-12600.

CR-102371 November 1, 1968

Astrionics System Handbook — Saturn Launch Vehicles. NAS8-14000. International Business Machines Corp.

CR-102372 April 15, 1969

Analytical and Experimental Development Program for Inflatable Solar Shields. NAS8-21132. General Dynamics.

CR-102373

AM Baseband Telemetry Systems. Volume 4: Problems Relating to AM Baseband Systems. NAS8-20172. University of Alabama. N70-14184.

CR-102376 November 2, 1969

A Study of Navigation Systems for Dual-Mode Lunar Roving Vehicles. NAS8-24858. University of Tennessee.

CR-102377 March 19, 1969

An Investigation of the Base Environment of the Uprated Saturn S-1B Booster at Mach Numbers 1.18 and 1.63 Using Short-Duration Experimental Techniques. Cornell Aeronautical Lab, Inc. X70-11224.

CR-102378 June 1968

Numerical Solutions to the Heat Conduction Equation Applicable to Thin Film Heat Transfer Gages. NAS8-21028. Hayes International Corp. X70-10809.

CR-102379 December 8, 1969

Suppression of Combustion Oscillations With Mechanical Damping Devices. Interim Report. NAS8-21310. Pratt & Whitney Aircraft.

CR-102380 April 10, 1969

MAN/System Integration Specialized Analysis. NAS8-21455. Matrix Corp.

CR-102381 November 1969

Study of Hydrodynamic Gyro Squeeze-Film Bearing. Final Report. NAS8-21169. Mechanical Technology Inc.

CR-102382 July 1, 1969

CO 2 Laser Modulation. NAS8-24197. Honeywell, Inc.

CR-102383 July 7, 1969

Design Development Fabrication and Delivery of Prototype Silicon Monolithic Amplifiers. Final Report. NAS8-20732. TRW Systems Group. N70-18436.

CR-102384 August 1969

AM-Baseband Telemetry Systems. Volume 5: Summary. NAS8-20172. University of Alabama. N70-17958.

CR-102385 August 31, 1969

Investigation of the Preparation of Materials in Space. NAS8-24683. General Electric Co. X70-11680.

CR-102386

Closed-Circuit Television ARC Guidance Adapter Kit for a Computerized Welding Skate, Phase 1. NAS8-24638. Lockheed Missiles and Space Co. N70-18269.

CR-102387 July 31, 1969

Optical Guidance System (OGS) for Rendezvous and Docking. NAS8-20717. Aerospace Optical Div. of ITT. N70-15815.

CR-102388 January 1, 1969

Applied Research and Feasibility Studies Experimental Investigation and Conceptual or Preliminary Design Engineering Applicable to Inverters for Motors Program. Final Report. NAS8-20832. Gulton Industries, Inc. N70-15992.

CR-102390 January 6, 1969

Modular Nuclear Vehicle Study. Phase IV: Nuclear Stage Development Program Sensitivity Analyses. NAS8-20007. Lockheed Missiles and Space Co. X70-11223.

CR-102391 April 7, 1969

Modular Nuclear Vehicle Study. Phase IV: Flight Safety Studies. NAS8-20007. Lockheed Missiles and Space Co. X70-11229.

CR-102392 October 14, 1968

Modular Nuclear Vehicle Study. Phase IV: Nuclear Ground Test Module, Its Ground Support Equipment and NRDS Facilities Requirements. Study of Modular Nuclear Vehicles, Technology Problems, Safety Systems, and Shield Optimization. NAS8-20007. Lockheed Missiles and Space Co. X70-11558.

CR-102393 December 26, 1968

Modular Nuclear Vehicle Study. Phase IV: Multiple Start Pressurization. Study of Modular Vehicles, Technology Problems, Safety Systems, and Shield Optimization. NAS8-20007. Lockheed Missiles and Space Co. X70-11559.

CR-102394 April 10, 1969

Modular Nuclear Vehicle Study. Phase IV: Stage Test Stand Nuclear Environmental Analysis. Study of Modular Nuclear Vehicles, Technology Problems, Safety Systems. NAS8-20007. Lockheed Missiles and Space Co. X70-11247.

CR-102395 February 15, 1969

Modular Nuclear Vehicle Study. Phase IV: Tank Bottom Geometry Study. NAS8-20007. Lockheed Missiles and Space Co. X70-11241.

CR-102396 March 17, 1969

Modular Nuclear Vehicle Study. Phase IV: NERVA Thrust Vector Control Requirements. NAS8-20007. Lockheed Missiles and Space Co. X70-11573.

CR-102397 August 15, 1969

A Study of the Mechanism of Chemical Reactivity of Nitrogen Tetroxide With Titanium Alloy. NAS8-30519. Hercules Research Center. X70-11246.

CR-102398 April 30, 1969

An Experimental Investigation of Solid Propellant Retrorocket Impingement Effects on Saturn Stages. NAS8-20027. Cornell Aeronautical Lab, Inc. X70-11222.

CR-102400 February 19, 1968

F-1 Bimonthly Progress Report. CONFIDENTIAL. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp.

CR-102401 April 19, 1968

F-1 Bimonthly Progress Report. CONFIDENTIAL. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp.

CR-102402 June 19, 1968

F-1 Bimonthly Progress Report. CONFIDENTIAL. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp.

CR-102403 August 19, 1968

F-1 Bimonthly Progress Report. CONFIDENTIAL. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp.

CR-102404 October 21, 1968

F-1 Bimonthly Progress Report. CONFIDENTIAL. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp.

CR-102405 August 6, 1968

Study of Minimum Pressure Loss in High Velocity Duct Systems. Interim Report No. 1. NAS8-21133. Southwest Research Inst.

CR-102406 September 29, 1969

Radial and Structural Characteristics of Rocket Engine Exhaust Plumes. NASw-16. Rocketdyne Div. of North American Rockwell Corp.

CR-102407 February 21, 1969

F-1 Engine Operation in The S-IC-3 Stage of the Saturn V AS-503 Flight. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp. X70-11282.

CR-102408 July 18, 1969

F-1 Engine Operation in the S-IC-5 Stage of the Saturn V AS-505 Flight. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp. X70-11261.

CR-102409 September 1969

Study of the General Mechanism of Stress Corrosion of Aluminum Alloys and Development of Techniques for Its Detection. Final Report. NAS8-20297. Tyco Labs, Inc. N70-14558.

CR-102410

Study of Inter-Facial Conductivity. NAS8-20126. P.E.C. Research Associates, Inc.

CR-102411 June 27, 1969

Development of Full In-Flight Acoustic Design Criteria Scaling Effects. Final Report. NAS8-21461. Baganoff Associates, Inc. N70-14524.

CR-102413 April 1969

Atmospheric Design Concepts for Cross-Beam Experiments. Final Report. NAS8-20107. ITT Research Inst. N70-15581.

CR-102415 August 1969

The Modification and Redesign of Moderate Depth Lunar Drill Assembly and Parts. NAS8-20820. Northrop Corp. X70-11714.

CR-102416 March 1969

On Flow Past a Cascade of Partially Cavitating Cambered Blades. NAS8-20625. Hydronautics, Inc. N70-15791.

CR-102417 October 15, 1969

Millimetric and Submillimetric Instrumentation Study of Solar Radiometers for Mapping and Flare Detection. NAS8-30161. Raytheon Co.

CR-102418 August 30, 1968

Fatigue Properties of Sheet Bar and Cast Metallic Ne Materials for Cryogenic Applications. NAS8-18734. Rocketdyne Div. of North American Rockwell Corp.

CR-102419 March 1967/February 1968

Modular Nuclear Vehicle Study Phase II. Vols. I, II, III, and IV. NAS8-20007. Lockheed Missiles and Space Co.

CR-102420

Cap User's Guide. NAS8-21131. Renssalaer Polytechnical Inst.

CR-102421 November 1969

Microwave Microelectronic Techniques Applied to Phase Shifters and Other Control Devices. Final Report. NAS8-21268. Sperry Microwave Electronics Co. Div. of Sperry Rand Corp. N70-17302.

CR-102422 August 1969/December 1969

Experimental Heat Chamber for Sterilization of Large Interplanetary Structures. NAS8-30139. Martin Marietta Corp.

CR-102423 September 1969

Rolling-Contact Bearing Reference Summary. H-5540A. Battelle Memorial Inst. N70-18925.

CR-102424 February 1968

Solid Lubricant Handbook for Use in the Space Industry. NAS8-1540. Midwest Research Institute.

CR-102425 February 28, 1969

Effects of High Pressure Hydrogen on Metals at Ambient Temperature. Final Report. NAS8-19. Rocketdyne Div. of North American Rockwell Corp. N70-18637.

CR-102426 June 30, 1969

Effect of Hydrogen Environment on Inconel 718 and Ti-6Al-4V Under Simulated J-2 Engine Operating Conditions. NAS8-19C. Rocketdyne Div. of North American Rockwell Corp. X70-12799.

CR-102427 August 29, 1969

Megawatt Solar Array Study. Final Report. NAS8-21396. Electro-Optical Systems, Inc. X70-12577.

CR-102431 April 30, 1969

Analysis, Design and Prototype Development of Squeeze-Film Bearings for AB-5 Gyro. Phase VI: Final Report Analytical Investigation on Dynamic Responses and Start-Up Process of Squeeze Film-Bearings. NAS8-11678. Mechanical Technology Inc. N70-18768.

CR-102432 April 1969

On the Start-Up Process in a Gaseous Squeeze-Film Thrust Circular Disk. NAS8-11678. Mechanical Technology Inc. N70-18854.

CR-102433 April 1969

Analysis Design and Prototype Development of Squeeze-Film Bearings for AB-5 Gyro. Phase V: Development of an Integral Design Prototype Squeeze-Film Bearing Supporting a Live AB-5 Gyro Float. Final Report. NAS8-11678. Mechanical Technology Inc. N70-18761.

CR-102434 July 11, 1968

Development of Space Stable Thermal Control Coating. NAS8-1379. ITT Research Inst.

CR-102435 July 1969

Preparation of Pigments for Space Stable Thermal Control Coatings. NAS8-21317. Ohio State University.

CR-102436 May 1, 1969

Voltage Controlled Monolithic Oscillator. Final Report. NAS8-20692. United Aircraft Corp. N70-18683.

CR-102437 November 1969

Development of Materials and Materials Application Concepts for Joint Use As Cryogenic Insulation and Micrometeoroid Bumpers. Annual Summary Report. NAS8-30130. Goodyear Aerospace Corp. X70-12197.

CR-102438 October 1969

Electrochemical Systems Heat and Mass Transfer. NAS8-21159. Inst. of Gas Technology IIT Center, Chicago. X70-12739.

CR-102439 September 9, 1969

Weight Reduction Study and Structural Analysis of the ST-124-M Stabilized Platform Gimbal System. NAS8-20348. Battelle Memorial Inst.

CR-102441

Repetitive Failure Evaluation Report. NAS8-5608. The Boeing Co.

CR-102442 January 1970

Radiative Aspects of Lunar Materials. Final Report. NAS8-21044. P.E.C Research Associates, Inc.

CR-102443 January 1970

Advanced Injector Concepts Investigation. Interim Report. NAS8-21052. Aerojet General Corp.

CR-102444 July 10, 1969

Thermally Resistant Polymers for Use as Fuel Tank Sealants. Annual Summary Report, 1 July 1968-30 June 1969. NAS8-21401. Monsanto Research Corp. N70-19871.

CR-102445 November 1969

Two Phase Flow and Heat Transfer in Porous Beds Under Variable Body Forces. Part I. NAS8-21143. University of Alabama, Bureau of Engineering Research.

CR-102447 January 1969

A Study of Major Coding Techniques for Digital Communication. Final Report. NAS8-20172. University of Alabama. N70-19873.

CR-102448 October 1969

Optical Cross-Beam Field Tests at ESSA Haswell Field Site, October 1969. NAS8-21049. Colorado State University. X70-12256.

CR-102449 May 23, 1969

Design, Development, Fabrication and Delivery of Fluidic Accelerometers. Final Report. NAS8-20729. General Electric Co.

CR-102451 July 10, 1969

A Study of Optimum Methods for Preparing Aluminum Surfaces of Welding. Final Report. NAS8-21354. IIT Research Inst. N70-18675.

CR-102452 November 11, 1969

Evaluation of Astrionics System Requirements for OSSA Launch Vehicles. Final Tech Report. NAS8-30516. Battelle Memorial Institute. X70-12590.

CR-102453 March 11, 1968

Design and Development of Microelectronic Circuits for Stabilization of a Gas Bearing Gyro Servo Loop. Phase Completion Report. NAS8-11916. Bendix Corp. N70-18976.

CR-102454 December 22, 1969

Testing of Dielectric Material and Application Techniques in Electronic Packaging. Final Report. NAS8-21333. General Electric Co. N70-20625.

CR-102455 November 3, 1969

Description and User's Guide: Gain Initialization Programs. NAS8-21131. Rensselaer Polytechnic Inst. N70-20135.

CONTRACTOR REPORTS

CR-102456 August 12, 1969

Launch Vehicle Trajectory Optimization Computer Program — Phase IV Summary Report. NAS8-30509. Northrop Corp. N70-18754.

CR-102457 August 12, 1969

Launch Vehicle Trajectory Optimization Computer Program — Phase V. Final Technical Report. NAS8-30509. Northrop Corp. N70-18788.

CR-102458 January 15, 1970

Suppression of Combustion Oscillations With Mechanical Damping Devices. NAS8-21310. Pratt & Whitney Aircraft.

CR-102459 January 1970

Development of Mechanical Plastic Sterile Insertion Engineering Model Hardware. NAS8-30002. Martin Marietta Corp. X70-12392.

CR-102460 September 1968

Base Flow and Separation Studies. Final Report. NAS8-20392. IIT Research Inst. N70-19762.

CR-102461 October 29, 1969

The Effect of Sonic Boom Exposure to the Guinea Pig Cochlea. NGL-19-001-068. Louisiana State University. N70-19774

CR-102462

Utilization of Liquid Nitrogen for Refrigerated Storage of Shrimp. NGL-19-001-068. Louisiana State University. N70-19865.

CR-102463 December 1969

Prediction of Structural Damping for Future Saturn Flights. Final Report. NAS8-21446. Lockheed Missiles and Space Co. N70-19797.

CR-102464 January 13, 1970

Stability Characterization of Advanced Injectors. Quarterly Progress Report. NAS8-20672. Aerojet-General Corp. X70-12673.

CR-102465 April 30, 1969

Saturn V Launcher Umbilical Tower Vibration Analysis. Vol. II: A Computer Program for Analysis of the Vibrational Characteristics of Large Linear Space Frames. NAS8-21301. Lockheed Missiles and Space Co. N70-19830.

CR-102466 April 30, 1969

Saturn V Launcher Umbilical Tower Vibration Analysis. Volume I: Response to Ground Wind Excitation. Final Report. NAS8-21301. Lockheed Missiles and Space Co.

CR-102467 April 9, 1968

Attitude Control for Passivation of S-IVB Stage. NAS8-20055. Sperry Rand Corp. X70-12860.

CR-102468 January 10, 1970

Cast Segment Evaluation September 18 to December 17, 1969. NAS8-30182. Rocketdyne Div. of North American Rockwell Corp. X70-12587.

CR-102470 August 1969

Mathematical Analysis of Aperiodic Events (Geomagnetic Activity). NAS8-30156. McDonnell-Douglas Astronautics Co. N70-19889.

CR-102471 September 1969

Measurement of Electric Fields in the Ionosphere. Final Report. NAS8-20663. Fairchild Hiller Corp. N70-24313.

CR-102472 August 1969

Quadrupole Mass Filter Design and Construction for Plasma Ion Analysis. NAS8-21391. Oklahoma State University.

CR-102474 October 6, 1969

Study of Crack Initiation Phenomena Associated With Stress Corrosion for Aluminum Alloys. NAS8-20396. Alcoa Research Lab.

CR-102475 October 31, 1969

Trajectory Computational Techniques Emphasizing Existence Uniqueness and Construction of Solutions to Boundary Problems for Ordinary Differential Equations. NAS8-21434. University of Wyoming.

CR-102476 January 13, 1970

Apollo/Saturn V Postflight Trajectory AS-507. NAS8-5608. The Boeing Co.

CR-102478 August 19, 1969

Adaptive Computing Techniques. Report on Optimization Techniques for Unimodal Functions. NAS8-21417. Bell Aerosystems Co. N70-19760.

CR-102479 August 29, 1969

The Effects of Point Defects and Dislocations on the Stress-Corrosion Susceptibility of Aluminum Alloys. NAS8-20471. Rocketdyne Div. of North American Rockwell Corp. X70-12905.

CR-102481 December 1969

An Investigation of Rocket Plume Impingement Effects on the Manned Orbital Workshop. NAS8-21084. Cornell Aeronautical Lab, Inc. X70-12702.

CR-102482 October 1969

Investigation of Multilayer Printed Circuit Board Materials. Final Report. NAS8-21477. Autonetic Div. of North American Rockwell Corp. N70-19844.

CR-102484 September 9, 1969

Two-Axis Fluidic Rate Gyro and Single-Axis Fluidic Accelerometer. Final Report. NAS8-20780. Kearfott Div. of Singer-General Precision, Inc. X70-12589.

CR-102485 January 1970

Development of Mechanical Plastic Sterile Insertion Engineering Model Hardware. Vol. II. NAS8-30002. Martin Marietta Corp. X70-12728.

CR-102486 August 1969

Experimental Heat Chamber for Sterilization of Large Interplanetary Structures. Final Report. NAS8-30139. Martin Marietta Corp. X70-12730.

CR-102487 December 1969

Propellant Slosh Coupling With Bending. Final Report. NAS8-21485. Lockheed Missiles and Space Co. N70-20417.

CR-102488 January 1970

Stability Characterization of Advanced Injectors — Design Guide. Vol. II: Operation of the Computer Program. Phase 2 — Final Report. NAS8-20672. Aerojet-General Corp.

CR-102489 March 26, 1970

Design Techniques for Modular Architecture for Reliable Computer Systems. NAS8-24883. International Business Machines Corp. X70-14636.

CR-102490 October 31, 1968

A Study of Hydrogen Slush and/or Hydrogen Gell Utilization. Vols. I, II. NAS8-20342. Lockheed Missiles and Space Co.

CR-102491 September 1969

Design and Fabrication of the Tooling for Installation of a Composite Insulation System on MSFC 105-Inch Diameter Tank. Final Summary Report. NAS8-24825. Goodyear Aerospace Corp. N70-25482.

CONTRACTOR REPORTS

CR-102492 July 3, 1969

Feasibility Study and Analysis of the Use of Computers to Prepare Monolithic Integrated Circuits for GSE. NAS8-24900. M & S Computing, Inc. N70-25333.

CR-102493 May 23, 1969

Design, Development, Fabrication, and Delivery of Fluidic Accelerometer. Final Report. NAS8-20729. General Electric Co.

CR-102494 June 1969

AM-Based Telemetry Systems. Volume II: Carrier Synthesis From AM Modulated Carriers. NAS8-20172. University of Alabama.

CR-102495

Repetitive Failure Evaluation Report. NAS8-5608. The Boeing Co.

CR-102496 July 1969

Preparation of Pigments for Space Stable Thermal Control Coatings. NAS8-21317. Ohio State University.

CR-102497 October 25, 1968

Stability Characterization of Advanced Injectors — Summary Final Report: Phase I. NAS8-20672. Aerojet-General Corp.

CR-102498 October 25, 1969

Stability Characterization of Advanced Injectors — Final Report: Phase I. NAS8-20672. Aerojet-General Corp.

CR-102499 July 17, 1969

Study of Minimum Pressure Loss in High Velocity Duct Systems. NAS8-21133. Southwest Research Inst. N70-25375.

CR-102500 July 31, 1969

Study on Thin Electrode Fuel Cells. NAS8-21311. Esso Research and Engineering Co.

CR-102501 1969

Analysis of Second Breakdown. Final Report. NAS8-21286. Newark College of Engineering. N70-24726.

CR-102502 September 9, 1969

Weight Reduction Study and Structural Analysis of the ST-124-M Stabilized Platform Gimbal System, Summary Report. NAS8-20348. Battelle Memorial Inst. X70-12861.

CR-102503 September 1969

Nonlinear Damping in Structures. NAS8-21435. Lockheed Missiles and Space Co. N70-20820.

CR-102504 August 1969

A Theoretical and Experimental Investigation of Acoustic Point Source Radiation in the Presence of a Reflecting and Refracting Plane. Final Technical Report. NAS8-21414. National Scientific Lab, Inc. N70-20760.

CR-102505 February 15, 1969

A Study of the Coupling of Acoustic Energy From the Troposphere to the Ionosphere. Final Technical Report. NAS8-21079. Avco Corp. N70-20589.

CR-102506 May 24, 1970

Space Thermal Control by the Use of Solid/Solid Phase Change Material. NAS8-21452. Midwest Research Inst.

CR-102507 August 1969

Optical Measurement of Multiplume Interaction. Interim Report. NAS8-21285. Lockheed Missiles and Space Co. N70-20676.

CR-102508 September 25, 1969

Research Study To Develop Means of Manufacturing Bonding Clips, Brackets and Joints and Pressure Sealing Joints With Uniform Stress Distribution. Final Report. NAS8-21380. Whittaker Corp.

CR-102509 September 1969

Ruggedized Gamma Radiation Detector. Final Report. NAS8-20840. North American Rockwell Corp. N70-20649.

CR-102510 January 1970

Hazard Detection Methods for a Lunar Roving Vehicle. Final Report. NAS8-25098. Grumman Aircraft Engineering Corp.

CR-102511 October 15, 1969

Evaluation and Application of Data From Low Gravity Orbital Experiment. Phase 2: Marker and Cell Method for Solution of Fluid Dynamics Problems. NAS8-21291. Convair Div. of General Dynamics. X70-13277.

CR-102512 July 11, 1969

Development of Space Stable Thermal Control Coating. Triannual Report. NAS8-5379. IIT Research Institute.

CR-102515 February 15, 1969

Design and Development of Low Noise Traveling Wave Tube Amplifiers for the 18- to 75-GHz Frequency Range. Final Report. NAS8-20658. Watkins-Johnson Co.

CR-102516 July 10, 1969

Thermally Resistant Polymers for Fuel Tank Sealants. NAS8-21401. Monsanto Research Corp.

CR-102517 July 31, 1969

Computer Programs for Prediction of Structural Vibrations Due to Fluctuating Pressure Environments. Vol. I. NAS8-21403. Chrysler Corp.

CR-102518 July 31, 1969

Computer Programs for Prediction of Structural Vibrations Due to Fluctuating Pressure Environments. Vol. II. NAS8-21403. Chrysler Corp.

CR-102519 April 14, 1969

Filtering and Optimization of Linear Stochastic Systems With Cross-Correlated Noise: An Application to Fine Pointing Control System. NAS8-20104. Auburn University.

CR-102520 June 1969

Study of a Four-Gimbal Stabilized Platform. NAS8-20104. Auburn University.

CR-102521 July 1969

Comparative Analysis of Acoustic Testing Techniques. Exhibit B: Determination of Test Time for Acoustic Qualification at Levels Other Than Specified Levels. NAS8-21425. Chrysler Corp.

CR-102522 September 30, 1969

Large Erectable Antenna for Space Application. Final Report. NAS8-21460. General Dynamics. N70-25762.

CR-102523 October 1968

Development of a Micrometeroid Accelerator. Final Report. NAS8-21103. MB Associates. N70-21783.

CR-102525 July 1968

Flat Cable Applications Study — Phase III. Vol. I. NAS8-20751. McDonnell-Douglas Astronautics Co.

CR-102526 July 1968

Flat Cable Application Study — Phase III. Vol. II. NAS8-20751. McDonnell-Douglas Astronautics Co.

CONTRACTOR REPORTS

CR-102527 January 12, 1968

ATM Optical Contamination Study. NAS8-20166. Brown Engineering — A Teledyne Co.

CR-102529 February 1968

Realiability Study of Zener Diodes Used in the Saturn Program. Final Technical Report NAS8-20315. Philco-Ford Corp. N70-21524.

CR-102530 May 1968

Experimental Hypervelocity Impact Research Program. Final Report. NAS8-20337. IIT Research Inst. N70-21602.

CR-102532 March 29, 1969

Design and Development of a Resonant Piston Compressor for Hermetically Sealed Platforms. NAS8-20720. Mechanical Technology Inc. N70-21893.

CR-102533 January 1970

Dynamic Analysis of Stability and Deployment of Inflatable Shell Structures. Final Report. NAS8-21480. University of Alabama. N70-22756.

CR-102534 December 1969

Prediction of Structural Damping for Future Saturn Flights. Final Report. NAS8-21446. Lockheed Missiles and Space.

CR-102535 December 15, 1969

Use of Non-Imaging Sensors for Hazard Avoidance During Movement of the Lunar Roving Vehicle. NAS8-25099. Bendix Corp.

CR-102537 October 31, 1969

Space Shuttle. Volume V: Subsystems and Weight Analysis. Final Technical Report. NAS9-9207. Convair Div. of General Dynamics. X70-13382.

CR-102538 January 1970

Research Study on Low Cost Earth Orbital Transportation System Synthesis by Economic Analysis — Econometrics. Final Report. Volume I. NAS8-30522. The Boeing Co. X70-13249.

CR-102539 January 1970

Research Study on Low Cost Earth Orbital Transportation System Synthesis by Economic Analysis — Econometrics. Final Report Volume II. NAS8-30522. The Boeing Co. X70-13250.

CR-102540 January 1970

Research Study on Low Cost Earth Orbital Transportation System Synthesis by Economic Analysis — Econometrics. Final Report. Volume 3: Cost and Weight Estimating Relationships. NAS8-30522. The Boeing Co. X70-13251.

CR-102541 January 1970

Research Study on Low Cost Earth Orbital Transportation System Synthesis by Economic Analysis — Econometrics. Final Report. Volume 4: The Shuttle Sizing Program User's Manual. NAS8-30522. The Boeing Co. X70-13252.

CR-102542 February 1, 1970

Study of Space Station Propulsion System Resupply and Repair. NAS8-25067. Martin Marietta Corp. N70-22830.

CR-102543

Integral Launch and Reentry Vehicle. Volume I: Configuration Definition and Planning. Part A — Sections 1 through 9. NAS9-9206. Lockheed Missiles and Space Co. X70-13329.

CR-102544 February 1970

Nuclear Flight System Definition Study — Potential Flight Test Payloads Barium Cloud Experiment. Volume I: Summary Report. NAS8-24975. Martin Marietta Corp. X70-13842.

CR-102545 February 1970

Nuclear Flight System Definition Study — Potential Flight Test Payloads Barium Cloud Experiment. Volume II: Detailed Technical Report. NAS8-24975. Martin Marietta Corp. X70-13843.

CR-102546 February 1970

Nuclear Flight System Definition Study — Potential Flight Test Payloads Barium Cloud Experiment. Volume III: Technology Report. NAS8-24975. Martin Marietta Corp. X70-13844.

CR-102547 December 31, 1969

Modular Nuclear Vehicle Study. Phase V: Flight Safety Studies. NAS8-20007. Lockheed Missiles and Space Co. X70-13609.

CR-102548 December 22, 1969

Modular Nuclear Vehicle Study. Phase IV: Radiation Analysis of a Nuclear Lunar Logistics Vehicle. NAS8-20007. Lockheed Missiles and Space Co. X70-13608.

CR-102549 October 31, 1969

Space Shuttle. Volume 1: Condensed Summary. Final Technical Report. NAS9-9207. Convair Div. of General Dynamics. X70-13378.

CR-102550 October 31, 1969

Space Shuttle. Volume 2: Final Vehicle Configurations. Convair Div. of General Dynamics. X70-13379.

CR-102551 October 31, 1969

Space Shuttle. Volume 3: Initial Vehicle Spectrum and Parametric Excursions. Convair Div. of General Dynamics. X70-13380.

CR-102552 October 31, 1969

Space Shuttle. Volume 4: Technical Analysis and Performance. Convair Div. of General Dynamics. X70-13381.

CR-102553 October 31, 1969

Space Shuttle. Volume 6: Propulsion Analysis and Tradeoffs. Convair Div. of General Dynamics. X70-13383.

CR-102554 October 31, 1969

Space Shuttle. Volume 7: Integrated Electronics. Convair Div. of General Dynamics. X70-13384.

CR-102555 October 31, 1969

Space Shuttle. Volume 8: Mission/Payload and Safety/Abort Analyses. Convair Div. of General Dynamics. X70-13385.

CR-102556 October 31, 1969

Space Shuttle. Volume 9: Ground Operations and Facility Requirements. Convair Div. of General Dynamics. X70-13386.

CR-102557 October 31, 1969

Space Shuttle. Volume 10. Program Development Cost Analysis and Technology Requirements. Convair Div. of General Dynamics. X70-13387.

CR-102558 May 6, 1969

Low Power Digital Data Storage Module. Final Report. NAS8-30104. Motorola, Inc. X70-13618.

CONTRACTOR REPORTS

CR-102559 January 15, 1970

Advanced Engine Aerospike Experimental Investigation. Final Report. CONFIDENTIAL. NAS8-20349. Rocketdyne Div. of North American Rockwell Corp.

CR-102560 December 1969

Three-Dimensional Flow Field From a Radial Vortex Filament in a Cylindrical Annulus. NAS8-20625. Hydronautics, Inc. N70-23423.

CR-102561 July 1969

Comparative Analysis of Acoustic Testing Techniques, Exhibit A. Final Report. NAS8-21425. Chrysler Corp. N70-24413.

CR-102562 December 1969

Correlation of Stress-Wave-Emission Characteristics With Fracture in Aluminum Alloys. NAS8-21405. Aerojet-General Corp. N70-23323.

CR-102566 December 1969

Limitations in Thermal Modeling. Final Report. NAS8-21159. Lockheed Missiles and Space Co.

CR-102567

Heat Rejection Systems for Electrochemical Equipment, Phase I. Final Report. NAS8-21499. General Electric Co. X70-13598.

CR-102568

Tracking Data Plotting and Printout System. Final Report. NAS8-11935. Trans-Data Inc.

CR-102569 December 22, 1969

Integral Launch and Reentry Vehicle. Volume I: Configuration Definitation and Planning Part B. NAS9-9206. Lockheed Missiles and Space Co.

CR-102570 September 1969

Development of Advanced Materials for Integrated Tank Insulation System for the Long Term Storage of Cryogens in Space. Final Report. NAS8-21330. Martin Marietta Corp. N70-23348.

CR-102571 June 15, 1969

A Technique for Frequency Analysis of Systems Containing Multiple Nonlinearities. NAS8-20104. Auburn University. X70-13597.

CR-102572 December 31, 1968

Quarterly Progress Report — Digital Data Sampling Modules. NAS8-30003. General Instrument Corp.

CR-102573 December 22, 1969

Integral Launch and Reentry Vehicle. Volume II: Technology Identification. Final Report. NAS9-9206. Lockheed Missiles and Space Co. X70-13625.

CR-102574

Integral Launch and Reentry Vehicle: Executive Summary Report — Space Shuttle Final Report. NAS9-9206. Lockheed Missiles and Space Co. X70-13624.

CR-102576 June 30, 1969

Propellant Expulsion Bladder for the Saturn V/S-IVB. Final Report. NAS8-21149. Thiokol Chemical Corp. N70-23277.

CR-102577 December 5, 1969

The 24-Inch Cassegrain-Coude Telescope. Final Report. NAS8-20805. Goerz Optical Co., Inc. N70-23730.

CR-102579 February 1970

Some Applications of Jet Noise Theory. NAS8-21060. Wyle Labs, Inc. N70-23282.

CR-102580 1969

Processing Application and Evaluation of Sealants for Fuel Tanks in Advanced Aero-Space Structures. NAS8-21399. Monsanto Research Corp.

CR-102581 October 15, 1969

Design and Develop Fast Scan Infrared Detection and Measuring Instrument. NAS8-11604. Raytheon Co.

CR-102582 January 1970

Low Gravity Sloshing in Rectangular Tanks. NAS8-24022. Southwest Research Inst.

CR-102583 October 15, 1968

Apollo-Saturn Emergency Detection System Description (AS-500 Series Vehicles). NAS8-14000. International Business Machines Corp. X70-13601.

CR-102584 December 22, 1969

Integral Launch and Reentry Vehicle. Final Report. Vol. III: Special Studies. Part A: Sections 1 through 3 and Appendix A. NAS9-9206. Lockheed Missiles and Space Co.

CR-102585 August 1969

AM-Baseband Telemetry System. Volume 5: Summary. NAS8-20172. University of Alabama.

CR-102587 December 1969

Experimental Heat Chamber for Sterilization of Large Interplanetary Structures, Addendum. NAS8-30139. Martin Marietta Corp. X70-13602.

CR-102588 December 22, 1969

Testing of Dielectric Materials and Applications Techniques in Electronic Packaging. Final Report. NAS8-21333. General Electric Co. X70-13607.

CR-102589 December 10, 1969

Fabrication Techniques for Shrouded Titanium Impeller. Final Report. NAS8-20761. Rocketdyne Div. of North American Rockwell Corp. N70-23376.

CR-102590

Post Ignition Hydrogen Detection System. Final Report. NAS8-20857. Nassau Instruments, Inc.

CR-102591 October 31, 1969

Trajectory Computational Techniques Emphasizing Existence, Uniqueness, and Construction of Solutions to Boundary Problems for Ordinary Differential Equations. NAS8-21434. University of Wyoming. N70-25965.

CR-102593 July 30, 1969

Multikilowatt Transmitter Study for Space Communications Satellite. Volume II: Technical Report. Phase 2. NAS8-21886. General Electric Co.

CR-102595 January 15, 1970

Advanced Injector Concepts Investigation. NAS8-21052. Aerojet-General Corp.

CR-102596 November 1969

The Development of Quality Standards for Bipolar ISI. Final Report. Vol. I. NAS8-21319. Texas Instruments Inc.

CR-102597

Design Documentation and Test Hardware for an Engineering Model of a Serpentuator. Final Report. NAS8-30166. Astro-Space Labs, Inc. N70-24311.

CR-102599 April 1969

Tooling Concept for Manufacturing Operations in Space. Final Report. NAS8-21279. Martin Marietta Corp.

CONTRACTOR REPORTS

CR-102600 February 1970

Study of Thermal Conductivity Requirements: High Performance Insulation. Final Report. NAS8-21347. Lockheed Missiles and Space Co. N70-24181.

CR-102601 June 1969

Study of Thermal Conductivity Requirements: MSFC 20-Inch and 105-Inch Cryogenic Tank Analyses. NAS8-21347. Lockheed Missiles and Space Co. N70-24180.

CR-102602

Study of Thermal Conductivity Requirements — Volume I: High Performance Insulation Thermal Conductivity Test Program. NAS8-21347. Lockheed Missiles and Space Co. N70-24178.

CR-102603 December 1968

Study of Thermal Conductivity Requirements — Volume II: Multiple Docking Adapter (MDA) Thermal Model. NAS8-21347. Lockheed Missiles and Space Co. N70-24179.

CR-102604 January 1970

Preliminary Design of a High Temperature Space Manufacturing Furnace. NAS8-21347. Lockheed Missiles and Space Co. N70-23933.

CR-102605 January 15, 1970

Evaluation and Application of Data From Low Gravity Orbital Experiment. Phase 2: Marker and Cell Method for Solution Fluid Dynamics Problems. Quarterly Progress Report. NAS8-21291. General Dynamics.

CR-102606 July 30, 1969

Multikilowatt Transmitter Study for Space Communications Satellites, Volume I, Phase 2. NAS8-21886. General Electric Co. X70-14430.

CR-102607 June 10, 1969

Study of Infrared Evaluation in Qualification and Failure Analysis of Semiconductor Devices. Final Report. NAS8-21219. Philco-Ford Corp. N70-25761.

CR-102608 April 6, 1970

Gaseous Hydrogen Detection System. Final Report. NAS8-24526. General Electric Co. N70-25297.

CR-102609 October 25, 1968

Stability Characterization of Advanced Injectors, Phase 1. Final Report. NAS8-20672. Aerojet-General Corp. N70-25301.

CR-102610 December 1968

Phased Array Antenna Comparison Studies, Phase 2 Milestone Report. NAS8-21481. Martin Marietta Corp. X70-14440.

CR-102611 February 1970

Prediction of Electron Density and Collision Cross Section. Volume I: Summary. NAS8-21022. Lockheed Missiles and Space Co.

CR-102612 February 1970

Prediction of Electron Density and Collision Cross Section. Volume II: Equilibrium Electron Density Prediction — A Mathematical Model. Lockheed Missiles and Space Co.

CR-102613 March 1970

Prediction of Electron Density and Collision Cross Section. Volume III: Preliminary Theoretical Analysis of the 1/20 Scale Model F-1 Plume. NAS8-21022. Lockheed Missiles and Space Co.

CR-102614 February 28, 1970

Behavior of Nozzles and Acoustic Liners in Three Dimensional Acoustic Fields. NGL-11-002-085. Georgia Inst. of Tech.

CR-102615 June 1969

Equivalent Mechanical Model of Propellant Sloshing in the Workshop Configuration of the Saturn S-IVB. Final Report. NAS8-21478. Southwest Research Inst. N70-26098.

CR-102616 August 1969

Portable Laser Absolute Gravimeter Study. Final Report. NAS8-21157. Spaco, Inc. N70-25373.

CR-102617 October 1, 1969

Frequency Stabilized Gas Laser. Final Report. NAS8-20631. Electronic Systems Western Div. of Sylvania Electric Products Inc.

CR-102618 May 1969

Development of Improved Performance High Speed Spin Bearing and Gyro Wheel Program. Final Report. NAS8-11356. Bendix Corp.

CR-102619 October 23, 1969

Design Investigation and Development of Design Improvements for ST124-M Stabilized Platform Slip Ring Capsules. Final Report. NAS8-20578. Poly-Scientific Div, Litton Precision Products, Inc.

CR-102620 February 1970

User's Manual Control System Optimization Hybrid Computer Program. Final Report. NAS8-30515. Lockheed Missiles and Space Co.

CR-102621 February 1970

Adaptive Digital Attitude Control Study. Final Report. NAS8-30515. Lockheed Missiles and Space Co.

CR-102622 March 1970

Response of Flexible Space Vehicle to Docking Impact. Volume I: Analytical Investigation. NAS8-21280. Martin Marietta Corp.

CR-102623 March 7, 1969

Application of the Techniques for Evaluating the Acoustic Sources of Background Noise in Wind Tunnel Facilities. NAS8-20336. Chrysler Corp.

CR-102624 December 31, 1969

High Performance Thermal Protection Systems. Final Report. Vol. II. NAS8-20658. Lockheed Missiles and Space Co.

CR-102625 March 7, 1969

Heat Rejection Systems for Electrochemical Equipment Fuel Cell Heat Rejection System. NAS8-21499. General Electric Co.

CR-102626 February 1970

Carbon Dioxide Laser Modulation. Final Report. NAS8-24197. Honeywell, Inc. X70-14425.

CR-102627 December 22, 1969

Integral Launch and Reentry Vehicle. Volume II: Technology Identification. Final Report. NAS9-9206. Lockheed Missiles and Space Co.

CR-102628 December 22, 1969

Integral Launch and Reentry Vehicle. Volume III: Special Studies Part A — Sections 1 through 3 and Appendix A. Final Report. NAS9-9206. Lockheed Missiles and Space Co.

CR-102629 December 22, 1969

Integral Launch and Reentry Vehicle. Vol. III: Special Studies Part B — Sections 4 and 5 With Appendixes B, C, and D. Final Report. NAS9-9206. Lockheed Missiles and Space Co.

CR-102630 December 22, 1969

Integral Launch and Reentry Vehicle. Executive Summary. Final Report. NAS9-9206. Lockheed Missiles and Space Co.

CR-102631 July 16, 1969

Final Report for Contract NAS8-21407 — May 8, 1968 through July 7, 1969. Regent of the University of California.

CR-102632 February 1970

Experimental Investigation of Turbulent Velocities in a Subsonic Circular Jet. NAS8-21060. Wyle Labs, Inc.

CR-102633 March 1970

Response of Flexible Space Vehicles to Docking Impact. Volume II: Numerical Investigation. NAS8-21280. Martin Marietta Corp. N70-25587.

CR-102634 February 27, 1970

Microcircuit Construction Analysis. Final Report. NAS8-25103. Battelle Memorial Inst. N70-25453.

CR-102635 August 1, 1969

Study of Hybrid Microcircuit Quality Standards, Inspection Criteria and Reliability Screening Techniques. Final Report. NAS8-21390. TRW Systems Group of TRW, Inc. N70-25299.

CR-102637 February 20, 1969

Design Environment Criteria. Final Report. NAS8-21420. General Electric Co.

CR-102638

Repetitive Failure Evaluation Report. NAS8-5608. The Boeing Co.

CR-102639

A Study of the Thermal Conductance of Bolted Joints. NGR-19-001-068. Louisiana State University. N70-25816.

CR-102640 May 19, 1970

Portable Astronaut's Test Kit. Vol. I. Final Report. NAS8-24296. Martin Marietta Corp.

CR-102641 July 24, 1969

Space Thermal Control by Use of Solid Phase Change Materials. NAS8-21452. Midwest Research Institute.

CR-102643 May 1970

Calibration of a Far Ultraviolet Spectrograph and a Study of Vacuum Spark Breakdown. NASr-7/NAS8-21391. Oklahoma State University. N70-26046.

CR-102644 April 10, 1970

Monthly Progress Report No. 2 for Fuel Cell Electrical Power System — March 1970. NAS8-25609. Allis-Chalmers.

CR-102647 March 1969

ATM Program. Final Report. NAS8-20860. Westinghouse Electric Corp.

CR-102648 August 28, 1968

Study of Techniques for the Reduction of Creep in Plated Wire Memories. Final Report. NAS8-21151. Aerospace Division of Honeywell, Inc.

CR-102649 January 15, 1970

Study on Thin Electrode Fuel Cells. Final Report. NAS8-21311. Esso Research and Engineering Co.

CR-102651 December 17, 1969

A Preliminary Design Study for a Cosmic X-Ray Spectrometer. NAS8-24585. Massachusetts Inst. of Tech.

CR-102653 November 17, 1969

Development of Space Stable Thermal Control Coating. Triannual Report. NAS8-5379. IIT Research Inst.

CR-102654

Development of Space Stable Thermal Control Coatings. Triannual Report. NAS8-5379. IIT Research Inst.

CR-102655 April 1970

Shock Propagation in a Target Subjected to Hypervelocity Impact of an Incident Projectile. NAS8-20166. Brown Engineering — A Teledyne Co.

CR-102656 March 1, 1970

Design and Development of an Integral Brushless DC Torquer Encoder. Final Summary Report. NAS8-24655. Bendix Corp.

CR-102657 September 30, 1969

Development Program for 35-Watt Traveling Wave Tube Space Amplifier. NAS8-20787. Watkins-Johnson Co.

CR-102658 August 1969

Prediction of Service Life of Polymeric Sealant Compositions for Fuel Tanks in Aero-Space Structures From Measurements of Viscoelastic Properties. Annual Report. NAS8-21398. Battelle Memorial Inst.

CR-102659 December 1969

Nonisentropic Finite — Amplitude Wave Generation. Final Report. NAS8-21406. North American Rockwell Corp.

CR-102660 November 1969

The Effects of a Hydrogen Environment on the Mechanical Properties of Forged Ti-6Al-4V ELI Weldments. Final Report. NAS8-21470. McDonnell-Douglas Astronautics Co.

CR-102661 January 23, 1970

Electron Shielding Studies. NAS8-11304. Gulf General Atomic Inc.

CR-102662 March 1970

Final Report. Investigation of Electron Interactions in Matter: Comparisons of Experimental and Calculated Electron Transmission and Bremsstrahlung Spectra for Electron Energies Below 3.0 MeV. NAS8-20521. LTV Research Center.

CR-102663 June 1969

Equivalent Mechanical Model of Propellant Sloshing in the Workshop Configuration of the Saturn I-IVB. NAS8-21478. Southwest Research Inst.

CR-102664 September 1968

16-Channel Multiplexer. Final Report. NAS8-20890. Philco-Ford Corp.

CR-102665 April 3, 1969

An Analysis of the Noise Reduction of Orthotropic Cylindrical Shells. Final Report. NAS8-20026. Bolt, Beranek and Newman, Inc.

CR-102666 April 15, 1970

Suppression of Combustion Oscillations With Mechanical Damping Devices. NAS8-21310. Pratt & Whitney Aircraft.

CR-102667 November 1969

Two-Phase Flow and Heat Transfer in Porous Beds Under Variable Body Forces. Final Report. Phase III. NAS8-21143. University of Alabama, Bureau of Engineering Research.

CR-102668 April 10, 1970

Cast Segment Evaluation. Quarterly Technical Progress Report. NAS8-30182. Rocketdyne Div. of North American Rockwell Corp.

CR-102670 March 31, 1970

A Mechanical Fastening Technique Development for Application in Space. Final Report. NAS8-21253. Martin Marietta Corp.

CR-102671 December 1969

Limitations in Thermal Similitude. Final Report. NAS8-21422. The Boeing Co.

CR-102672 November 15, 1969

Investigation of the Preparation of Materials in Space Task IV — Field Management for Weightless Containerless Processing. NAS8-24683. General Electric Co.

CR-102673 1969

Random Vibration of Interconnected Systems. NAS8-2504. Massachusetts Inst. of Tech.

CR-102674 March 18, 1970

Fine Sun Sensor-Signal Conditioner. Final Report. NAS8-30033. Motorola Inc.

CR-102675 March 1970

Brushless DC Motor and Controller. Final Report. NAS8-25085. General Electric Co.

CR-102676 February 1970

Final Report for Formulation of a Telemetry Computer Program. NAS8-24017. Martin Marietta Corp.

CR-102677 April 1, 1970

Evaluation and Application of Data from Low-Gravity Orbital Experiment — Phase I. Final Report. NAS8-21291. General Dynamics.

CR-102678

Theoretical Study of the Radiative Emissivity of the Materials. NAS8-20365. P.E.C. Research Associates, Inc.

CR-102679 July 30, 1969

Multikilowatt Transmitter Study for Space Communications Satellites. Summary Report. Phase 2 — Vol. I. NAS8-21886. General Electric Co.

CR-102680 November 1969

Study of Atmospheric Effects on Optical Communications and Optical System. Final Report. NAS8-30507. University of Alabama.

CR-102681 January 1970

Feasibility Study of a High Energy Astronomy Observatory (HEAO) Spacecraft. Summary Report. Volume 2 — Appendices. NAS8-20166. Brown Engineering — A Teledyne Co.

CR-102682 June 8, 1968

Saturn V AS-503 D Launch Vehicle Flight System Dispersion Analysis — Final. (U) CONFIDENTIAL. NAS8-5608. The Boeing Co.

CR-102683 October 24, 1968

Summary of Engine Characteristics Considered in Plume Definition Study. Lockheed Missiles and Space Co.

CR-102684 November 1968

Pretest Analytical Study of Velocity and Turbulence Measurement in a Supersonic Cold Flow Jet Using the Laser Velocimeter. NAS8-20082. Lockheed Missiles and Space Co.

CR-102685 September 13, 1968

Preliminary Data for Plume Definition of the R4D Engine for the Command Service Module Reaction Control System. NAS8-20082. Lockheed Missiles and Space Co.

CR-102686 August 1969

Forces Due to a Command Service Module Reaction Control Motor Plume Impinging on the Saturn V (Dry Workshop Version). NAS8-20082. Lockheed Missiles and Space Co.

CR-102687 May 1970

Theory Design and Performance of a Coaxial Exploding Wire System. NAS8-21391. Oklahoma State University.

CR-102688 February 20, 1970

Development of Circuitry for a Multikilowatt Transmitter for Space Communication Satellites. Interim Technical Report. NAS8-24771. General Electric Co.

CR-102689 January 1970

The Unsteady One Dimensional Expansion of Oxygen. NAS8-21028. Hayes International Corp.

CR-102691

Final Report for the 10-Watt "S" Band Transmitter Model TR-2210. NAS8-20783. Teledyne Telemetry — A Teledyne Co.

CR-102692 December 18, 1969

Pre-Flight Certification Report for Valve, Manual Operated, Calmec Part No. 1045; MSFC 20M32042. NAS8-30107. AMETEK/ Calmec.

CR-102693 September 1969

Study of the General Mechanism of Stress Corrosion of Aluminum Alloys and Development of Techniques for Its Detection. NAS8-20297. Tyco Labs.

CR-102695 March 1969

Development of Prototype Muffler Diffuser Assemblies for S-IVB Workshop Ventilation Fans. NAS8-20026. Bolt, Beranek and Newman, Inc.

CR-102696 March 1970

Zero Gravity Solidification — Space Environmental Effects on Solidification Study. Final Report. NAS8-21123. Lockheed Missiles and Space Co.

CR-102697 May 5, 1970

A Study of Spallation Resulting from Hypervelocity Impact-Generated Waves. NAS8-20166. Brown Engineering — A Teledyne Co.

CR-102698 April 1970

Corrections to Observations of Intensities on the Sun. NAS8-20166. Brown Engineering — A Teledyne Co.

CR-102699 July 1968

Application of Heat Pipes to Spacecraft Thermal Control Problems. NAS8-20073. Brown Engineering — A Teledyne Co.

CR-102701 May 1, 1970

Switch Program Documentation. Interim Report. NAS8-21315. International Business Machines Corp.

CR-102702 November 1969

Study of Atmospheric Effects on Optical Communications and Optical System. Final Report. NAS8-30507. University of Alabama.

CR-102703 January 25, 1968

Study of the Methods for the Numerical Solution of Ordinary Differential Equations. Final Report. NAS8-20014. Georgia Inst. of Tech.

CR-102704

Digital Data Sampling Modules. Final Report — Part I. NAS8-30003. General Instrument Corp.

CR-102705

Digital Data Sampling Modules. Part II: System Controller. NAS8-30003. General Instrument Corp.

CR-102706 April 1970

Volume I: Operational Procedure for Determining Space Vehicle Response to Wind Turbulence. NAS8-21325. Martin Marietta Corp.

CR-102707

Volume II: Operational Procedure for Determining Space Vehicle Response to Wind Turbulence. NAS8-21325. Martin Marietta Corp.

CR-102708 December 1969

Two Phase Flow and Heat Transfer in Porous Beds Under Variable Body Forces. Final Report. Part IV. NAS8-21143. University of Alabama.

CR-102709 February 1970

Control System Optimization for Saturn V Launch Vehicles Using Gradient Techniques. Final Report. NAS8-30515. Lockheed Missiles and Space Co.

CR-102710 1970

Final Project Report for a Nitrogen Pressure Regulator P/N 627000. NAS8-30149. Fairchild Hiller Corp.

CR-102711 January 5, 1970

Large Telescope Experiment Program (LTEP). Final Technical Report. Volume 1: Summary Report. NAS8-21497. Lockheed Missiles and Space Co.

CR-102712 March 1970

Liquid Hydrogen Propellant Logistics Study. NAS8-25147. Linde Div. of Union Carbide Corp.

CR-102713 March 1970

Search for Good Algorithms for Practical Solutions to Discrete Optimization Problems. Final Report. NAS8-11189. University of Tennessee.

CR-102714 February 1970

Automated Mars Surface Sample Return Mission System Study. Volume I: Summary. NAS8-24714. Northrop Corp.

CR-102715 February 1970

Automated Mars Surface Sample Return Mission System Study. Volume IIA: Mission Analysis. NAS8-24714. Northrop Corp.

CR-102716 January 31, 1969

Study of Deployment Retraction Techniques for Flexible, Roll-Up Solar Arrays. NAS8-21202. Fairchild Hiller Corp.

CR-102717 July 31, 1969

Study of Thin Electrode Fuel Cells. NAS8-21311. Esso Research and Engineering Co.

CR-102718 April 30, 1970

Investigations of the Potential Performance Characteristics of Selected Contract Lubricants for Applications in Miniature Slip-Ring Capsules of the Type. Final Technical Report. NAS8-21323. Battelle Memorial Inst.

CR-102720 June 1970

Dynamics of an Elastic Space Station. NAS8-24768. Lockheed Missiles and Space Co.

CR-102721 October 25, 1968

Stability Characterization of Advanced Injectors. Report on Phase I. NAS8-20672. Aerojet-General Corp.

CR-102722 December 1969

Thermodynamic Improvements in Liquid Hydrogen Turbopumps. NAS8-20324. Rocketdyne Div. of North American Rockwell Corp.

CR-102723 March 1970

Final Engineering Report — Phased Array Step Recovery Diode Modules. NAS8-21408. Ryan Aeronautical Co.

CR-102724 July 1968

Application of Heat Pipes to Spacecraft Thermal Control Problems. NAS8-20073. Brown Engineering — A Teledyne Co.

CR-102725 December 1969

Radial and Axial Transmissibility Characteristics of Typical Rocket Vehicle Structure. NAS8-21426. North American Rockwell Corp.

CR-102726 May 1970

Investigation of the Steady Expansion of a Gaseous Axisymmetric Jet Into a Vacuum. NAS8-21490. Lockheed Missiles and Space Co.

CR-102728 February 1970

Automated Mars Surface Sample Return Mission System Study. Volume II: Systems Analysis and Conceptual Design. NAS8-24714. Northrop Corp.

CR-102729 February 1970

Automated Mars Surface Sample Return Mission System Study. Volume III: Technology. NAS8-24714. Northrop Corp.

CR-102730 Feburary 1970

An Investigation of Tandem Row High Head Pump Inducers. NAS8-20625. Hydronautics, Inc.

CR-102731

Zero Gravity Crystal Growth. Final Report. NAS8-24509. Westinghouse Electric Corp.

CR-102732 March 1970

Analysis of Fluid Sloshing in Arbitrary Tanks Having Rotational Symmetry — A Correction for Low Gravity Conditions. Volume II: Computational Application. NAS8-21272. Unidev Corp.

CR-102733 April 1970

Programming Manual — Lockheed Orbital Heat Rate Package (LOHARP). NAS8-30514. Lockheed Missiles and Space Co.

CR-102734 January 1970

Outer-Planet Exploration Missions. Part B-Vol. VI. Final Report. Technology Development. NAS8-24975. North American Rockwell Corp.

CR-102735 March 1970

Validation of Monolithic Circuit Test Standards Through an Integrated COS/MOS Multiplexer. Final Report. NAS8-21440. RCA Electronic Components.

CR-102736 May 15, 1970

Experiment Control and Data Processing Requirements Specification Report. NAS8-25471. System Development Corp.

CR-102737 January 1970

Outer-Planet Exploration Missions. Final Report. Part B. Vol. III: Mission Analysis. Section 4 through Appendix. NAS8-24975. North American Rockwell Corp.

CR-102738 May 1970

Lunar Vehicle Hazard Detection Advanced Laser Tracking Technique. Final Report. NAS8-25109. ITT.

CR-102739 January 1970

Outer-Planet Exploration Missions. Part B — Final Report. Vol. IV: Conceptual Design. NAS8-24975. North American Rockwell Corp.

CR-102740 January 1970

Outer-Planet Exploration Missions. Part B — Final Report. Vol. I: Summary. NAS8-24975. North American Rockwell Corp.

CR-102741 January 1970

Outer-Planet Exploration Missions. Part B — Final Report. Volume V: Mission and System Evaluation and Implementation. NAS8-24975. North American Rockwell Corp.

CR-102742 April 29, 1970

Thermally Resistant Polymers for Fuel Tank Sealants. NAS8-21401. Monsanto Research Corp.

CR-102743 January 1970

Development of Conformal Coating Material. NAS8-21336. Thiokol Chemical Corp.

CR-102744 January 1970

Outer-Planet Exploration Missions. Part B — Final Report. Volume IV: Conceptual Design Section 4.0 through Appendixes. NAS8-24975. North American Rockwell Corp.

CR-102745 January 1970

Outer-Planet Exploration Missions. Part B — Final Report. Volume III: Mission Analysis Sections 1 through 3. NAS8-24975. North American Rockwell Corp.

CR-102746 March 20, 1970

Design and Construction of a Pulse Width Modulated Signal Generator Prepared by Amplifying Systems Lab. Annual Report: Part 1. NAS8-11344. Auburn University.

CR-102747 March 1970

Some Aspects of Viscous Chemically Reacting Moderate Altitude Rocket Exhaust Plumes. Final Report. NAS8-21264. General Applied Science Lab.

CR-102748 June 1970

Design and Fabrication of Wheels for a Lunar Surface Vehicle. Volume II: Proposed Test Plan. Final Report. NAS8-25193. Grumman Aerospace Corp.

CR-102749 March 1970

Investigation of the Preparation of Materials in Space. Final Report. NAS8-24683. General Electric Co.

CR-102750 May 1, 1970

Improved Infrared Photomultiplier. Final Report. NAS8-20788. Electronic Systems Div. of Sylvania Electric Products Co.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

ABERG, J. O. S&E-CSE-S
CUTCHINS, M. A.

Products of a System Engineer. March 25, 1970. Publication in Journal of System Engineering.

ALEXANDER, MARGARET B. S&E-AERO-YA

See Kaufman, John W.

ALLEN, R. V. S&E-ASTR-RMH

See Caruso, Salvadore V.

ALLEN, R. V. S&E-ASTR-RMH

Development and Fabrication of a Microelectronic Control Accelerometer System. January 20, 1970. Fourth NASA Microelectronics Symposium. Langley Research Center, Hampton, Virginia.

ANDRESSEN, C. E., JR. PM-PR-MGR

Management Information Systems — Lessons Learned in the Apollo Program. October 8, 1969. Region 3 IEEE Convention, Huntsville, Alabama.

ANDREWS, L. E. S&E-AERO-YS

See Weidner, Don K.

ARNETT, G. M. S&E-SSL-TR
ZWIENER, J. M. S&E-SSL-TR
LINTON, R. C. S&E-SSL-TR

Space Environmental Simulation Optical Degradation. October 27, 1969. American Society for Testing and Materials, Cincinnati, Ohio.

ATKINS, HARRY S&E-SSL-TE

IR Stellar Photometry in the Wavelength Region From 1 to 3 Microns. March 25, 1970. MSFC/Optical Society of America. Huntsville, Alabama.

BAILEY, GEORGE A. S&E-ASTR-RM

Investigation of Silicon Nitride Prepared by the Nitridation of Silane and Ammonia for Memory Applications. May 17, 1970. 1970 Government Microcircuit Applications Conference, Fort Monmouth, New Jersey.

BANNISTER, T. C. S&E-SSL-TR

Crystal Growth. March 27, 1970. North Alabama Chapter of American Society of Mechanical Engineers, Huntsville, Alabama.

BANNISTER, T. C. S&E-SSL-T
GRODZKA, P. G.

Surface Tension Convection During Float-Zone Refining. February 3, 1970. Fourth International Conference on Electron and Ion Beam Science and Technology, Los Angeles, California.

Surface Tension Convection During Float-Zone Refining. February 10, 1970. Fourth International Conference of the Electrochemical Society, Los Angeles, California.

BANNISTER, T. C. S&E-SSL-TR
MURRILL, E.
BREED, L.

Solid-Solid Phase Transitions Determined by Differential Scanning Calorimetry. August 25, 1969. Midwest Regional Meeting of the American Chemical Society, Kansas City, Missouri.

BARLOW, WILLIAM R. S&E-QUAL-FP

See Nowakowski, M. F.

BEAL, JAMES B. S&E-QUAL-ARM

Nondestructive Testing — Potential Space Applications. October 28, 1969. Eastern Chapter of the American Society for Nondestructive Testing, Montreal Quebec, Canada.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

Paraphysics and Parapsychology — Recent Developments Associated With Bio-Electric Field Effects. February 12, 1970. Publication in ANALOG Science Fiction — Science Fact Publication.

Also Physical Research Foundation, Inc. Durham, N. C.

BEAMAN, ROBERT E. PM-SAT-E
WILKENSON, WILLIAM E. PM-SAT-E

Saturn V Launch Vehicle. October 8, 1969. Publication in AIAA Journal.

BELL, C. C.
FORWARD, R. L.
WILLIAMS, HARVELL P. S&E-SSL-SG

Simulated Terrain Mapping With the Rotating Gravity Gradiometer. September 29, 1969. First Invitational Symposium on Dynamic Gravimeters, Fort Worth, Texas.

BERGE, L. H. S&E-ME-A

Positioning and Handling in Weightless Environment. March 17, 1970. Seventh Space Congress, Cocoa Beach, Florida.

BEYLICH, A. E. S&E-AERO-A

Condensation in Carbon Dioxide Jet Plumes. March 30, 1970. Publication in AIAA J.

BLUMRICH, JOSEF F. PD-DO-SL

Design — Regaining the Ability To Design Well Is Both an Obligation and an Opportunity. January 13, 1970. Publication in Journal of Science.

BORELLI, M. T. S&E-ASTR-A

Some Basic Characteristics of Single-Phase RC Communicated Networks. February 4, 1970. Publication in IEEE Circuit Theory.

BROUSSARD, P. H., JR. S&E-ASTR-GC

See Walls, B. F.

BROWN, ROBERT L. S&E-QUAL-ARM

Television System for Neutron Radiography Using Small Sources. July 1969. American Nuclear Society, Los Angeles, California.

BROWN, S. C. S&E-AERO-YT

Simulating the Consequence of Cloud Cover on Earth Viewing Space Missions. September 24, 1969. Proceedings of American Astronautical Society National Meeting, Las Cruces, New Mexico.

BUCHANAN, H. J. S&E-AERO-D

See Ryan, Robert S.

BURNS, ROWLAND E. S&E-AERO-GT

A Bounded State Variable Problem: A Literature Review. August 21, 1969. AIAA Eighth Aerospace Sciences Meeting, New York, New York.

Optimal Second Stage Trajectories for the Shuttle Vehicle. January 7, 1970. 16th Annual Meeting of the American Astronautical Society, Anaheim, California.

BUTLER R, J. H.
WEIDNER, DON K. S&E-AERO-YS

Geomagnetic and Latitudinal Density Variations From Low Altitude Satellite Data. February 3, 1970. 51st Annual Meeting of the American Geophysical Union, Washington, D. C.

BYERS, J. K. S&E-ASTN-SOI

GERT Networks in Reliability Prediction. March 13, 1970. AIIE National Convention, Cleveland, Ohio.

CAMP, DENNIS W. S&E-AERO-YE

Response Tests of Cups, Vanes, and Propeller Wind Sensors. February 10, 1970. Publication in Journal of Applied Meteorology.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

CARUSO, SALVADORE V. S&E-ASTR-RMH

Development of Trimming Techniques for Microcircuit Thick-Film and Thin-Film Resistors. January 20, 1970. Fourth NASA Microelectronics Symposium, Langley Research Center, Hampton, Virginia.

See Filip, George L.

CARUSO, SALVADORE V. S&E-ASTR-RMH
ALLEN, R. V. S&E-ASTR-RMH

Development of Trimming Techniques for Microcircuit Thick-Film and Thin-Film Resistors. August 18, 1969. University of Missouri, Rolla, Missouri.

Development of Trimming Techniques for Microcircuit Thick-Film and Thin-Film Resistors. May 14, 1970. Hybrid Microelectronics Symposium, Long Beach, California.

CARUSO, VINCENT P. S&E-ME-M

Future Concepts for Space Work Shop. October 28, 1969. Symposium, Purdue University, LaFayette, Indiana.

CATALDO, CHARLES E. S&E-ASTN-MX

NASA Space Shuttle Materials Technology Review. March 13, 1970. Air Force Materials Symposium, Miami Beach, Florida.

CLUBB, JERRY J. S&E-ASTR-IT

See Frost, Walter O.

CODY, JOSEPH C. S&E-ASTN-P

Environmental Control of AAP Orbital Assembly. August 25, 1969. SAE National Aeronautics and Space Eng. and Man. Meeting. Los Angeles, California.

COSTES, NICHOLAS C. S&E-SSL-N

Apollo 11 Soil Mechanics Investigation. March 10, 1970. ASCE-AIAA Specialty Conference, Houston, Texas.

Apollo 11 Soil Mechanics Investigation. March 19, 1970. Apollo 11 Lunar Science Conference, Houston, Texas.

Apollo 11 Soil Mechanics Investigation 45-Day Mission Report. September 26, 1969. ASCE Annual and Environmental Meeting, Chicago, Illinois.

CURRIE, ROY E., JR. S&E-CSE-L

Lunar Roving Vehicle. October 13, 1969. IEEE Region 3 Convention, Huntsville, Alabama.

CUTCHINS, DR. M. A. A&TS-TU

Subtleties of Saturn System Engineering. March 25, 1970. Transactions of SM 70 Conference, Los Angeles, California.

CUTCHINS, DR. M. A. A&TS-TU
McCRARY, S. E. A&TS-TU

Improving Instruction Through System Engineering. March 18, 1970. Publication in *Engineering Education*.

DAILEY, CARROLL C. PD-MP-S
HEYER, JAMES PD-DO-DIR

Conceptual Definition of a High Energy Astronomy Observatory. April 21, 1970. 21st International Astronautical Congress of the International Astronautical Federation, Constance (German Federal Republic).

DALTON, CHARLES C. S&E-AERO-T

Comments on Average Relative Velocity of Sporadic Meteoroids in Interplanetary Space. January 7, 1970. Publication in AIAA.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

DAVIS, B. K. S&E-CSE-VM

Polyurethane Foam Applications. May 6, 1970. Technology Exchange Meeting, Cambridge, Massachusetts.

DEMOREST, K. E. S&E-ASTN-MEL

An Investigation of Dry Lubricated Gears for Use in Vacuum. September 5, 1969. AFML-MRI Solid Lubrication Conference, Kansas City, Missouri.

DEVRIES, LEONARD L. S&E-AERO-Y

See Nurre, Gerald S.

DEVRIES, L. S&E-AERO-Y
MOE, K.
SHIMAZAKI, T.

Computations for the Improvement of Global Atmospheric Models. January 20, 1970. AIAA's Fourth National Conference on Aerospace Meteorology, Las Vegas, Nevada.

DUVE, G. C. S&E-AERO-AUE

See Poe, J. W.

EDWARDS, DR. THOMAS R. S&E-SSL-P

An Approach to Contamination Identification. October 23, 1969. Publication in the Journal of the Optical Society of America.

An Approach to Quantitative Mass Analysis. November 20, 1969. 18th Annual Conference on Mass Spectrometry, San Francisco, California.

An Approach to Quantitative Mass Analysis. October 6, 1969. Southeast Section American Physical Society, Gainesville, Florida.

Multiparameter Optimization Applied to Spectral Data. February 3, 1970. Annual meeting of the Academy of Sciences, Auburn University, Auburn, Alabama.

ELLSWORTH, J. DENNIS S&E-ASTR-SGA
MCPHERSON, WAYNE

Saturn-Apollo Launch Vehicle Navigation System. December 9, 1969. National Space Meeting of the Institute of Navigation, NASA Ames Research Center, Mountain View, California.

Saturn V Launch Vehicle Navigation System. February 11, 1970. National Space Meeting of the Institute of Navigation, NASA Ames Research Center, Mountain View, California.

EULER, HAROLD C. S&E-AERO-YS

Solar Activity Predictions for Atmospheric Models. January 20, 1970. AIAA Fourth National Conference on Aerospace Meteorology, Las Vegas, Nevada.

FALLS, LEE W. S&E-AERO-YT
WILLIFORD, W. O.
CARTER, M. C.

Probability Distributions for Thunderstorm Activity at Cape Kennedy. August 8, 1969. Publication in Journal of Applied Meteorology.

FELIX, A. R. S&E-AERO-AE

MSFC, High Reynolds Number Tube Tunnel. March 13, 1970. 33rd Meeting of the Supersonic Tunnel Association, El Segundo, California.

FICHTL, DR. GEORGE H. S&E-AERO-YE

Power Spectra of Atmospheric Flows in the Design of Space Vehicles. November 20, 1969. AIAA Fourth National Conference on Aerospace Meteorology, Las Vegas, Nevada.

Longitudinal and Horizontal Lateral Spectra of Turbulence in the Atmospheric Boundary Layer. July 14, 1969. AGARD Specialists Meeting, Munich, Germany.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

FIELDS, STANLEY A. S&E-SSL-TE

Grazing Incidence X-Ray Optical System. March 30, 1970. 47th Annual Meeting of the Alabama Academy of Sciences, Auburn University, Auburn, Alabama.

FIELDS, STANLEY A. et al S&E-SSL-TE

The Reflection of X-Rays by Optical Surfaces. March 25, 1970. MSFC/Optical Society of America, Huntsville, Alabama.

FILIP, GEORGE L. S&E-ASTR-RM
CARUSO, SALVADORE V. S&E-ASTR-RM

Development of a Container for Handling, Testing, and Storing Discrete Microelectronic Components. August 18, 1969. University of Missouri, Rolla, Missouri.

FOUNTAIN, JAMES A. S&E-SSL-TE
WEST, EDWARD A. S&E-SSL-TE

Thermal Conductivity of Particulate Basalt as a Function of Density in Simulated Lunar and Martian Environments. September 15, 1969. Publication in Journal of Geophysical Research.

FOUNTAIN, WALTER F. S&E-SSL-TE

Infrared Measurements of the Moon. March 3, 1970. MSFC/Optical Society of America, Huntsville, Alabama.

FROST, WALTER O. S&E-ASTR-IT

Introduction to AM Baseband Telemetry Techniques. January 19, 1970. Publication in The Telemetry Journal.

FROST, WALTER O. S&E-ASTR-IT
CLUBB, JERRY J. S&E-ASTR-IT

Multiplex Data Bus Techniques. June 22, 1970. Space Shuttle Technology Conference, NASA Headquarters, (Lewis Research Center), Cleveland, Ohio.

FUNK, B. H., JR. S&E-AERO-AF
CIKANEK, H. A., JR.

One-Shot Measurements of the Decay of Supersonic Aerodynamic Turbulence. July 10, 1969. Basic Noise Research Conference, Washington, D. C.

FUNSTON, WILBUR H. PD-MP

Space Age Orchid Propagation. April 28, 1970. Space Flight Magazine of the British Interplanetary Society.

GATES, D. W. S&E-SSL-T

Coated Metals for Thermal Control. August 22, 1969. ASM William Hunt Eisenman Conference, St. Paul, Minnesota; San Francisco, California; and Philadelphia, Pennsylvania.

GREENWOOD, TERRY F. et al. S&E-AERO-AT

Analysis of Liquid Rocket Propellant Engine Exhaust Plumes. April 29, 1970. AIAA Thermophysics Conference, Los Angeles, California.

GRINER, DONALD B. S&E-ASTR-RP

Dual Beam Photometer for Optical Thin Film Measurements. March 9, 1970. MSFC/Optical Society of America, Huntsville, Alabama.

GUEST, STAN et al. S&E-AERO-AU

Determination of Press Cross Correlation on a Rocket Vehicle Surface. November 3, 1969. Acoustic Society Convention, San Diego, California.

HAEUSSERMANN, WALTER S&E-CSE-DIR

Description and Performance of the Saturn Launch Vehicle's Navigation, Guidance, and Control System. December 3, 1969. Third IFAC Symposium on Automatic Control in Space, Toulouse, France.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

HAGYARD, DR. MONA J. S&E-SSL-TT

Dynamics of Sunspots: A Compressible MHD Model. March 10, 1970. 132nd Meeting of the American Astronomical Society, Boulder, Colorado.

HAMITER, LEON S&E-QUAL-FP

Large Scale Integrated Circuits for Space Electronics. August 1, 1969. Eighth International Symposium on Space Technology and Science, Tokoyo, Japan.

HARDAGE, O. M., JR. S&E-AERO-MF

Apollo 12 Mission. November 19, 1969. ACME Club meeting. Huntsville, Alabama.

HARRISON, JAMES K. PD-MP-P

Effect of the Moon's Infrared Emission on Thermal Calculations. October 13, 1969. Publication in AIAA Journal.

HASTINGS, L. J. S&E-ASTN-PFA

See Patterson, William

HELLER, GERHARD B. S&E-SSL-DIR

Scientific Activities in Space Sciences Laboratory. April 9, 1970. Gas Dynamics Colloquium, Northwestern University, Evanston, Illinois.

The Status of Thermophysics as a Multidiscipline Area in Astronautics and Aeronautics. June 23, 1970. AIAA Fifth Thermophysics Conference, Los Angeles, California.

HERNDON, RALPH H. S&E-ME-MES

Flat Conductor Cable Technology. May 11, 1970. Innovations in Housing (ABTS ASSOC), Cambridge, Massachusetts.

HEYER, JAMES PD-DO-DIR

See Dailey, Carroll C.

HILL, C. K. S&E-AERO-YE

See Kaufman, J. W.

HILL, ROBERT J. PD-DO-PM

A Bound for the Spectral Radius of Tournament Matrices. May 8, 1970. Theory Conference, Auburn, Alabama.

HOOVER, DR. RICHARD B. S&E-ASTR

Diffraction Plates for Classroom Demonstrations. July 30, 1969. Publication in American Journal of Physics.

Optical Phenomena in Diatomaceae Collegiate Academy. April 13, 1970. 54th Annual Meeting, Arkansas Academy of Science and College of the Ozarks Research Center, Russellville and Clarksville, Ark.

X-Ray Astronomy. April 13, 1970. Senior Academy Banquet, 54th Annual Meeting, Arkansas Academy of Science, Russellville, Arkansas.

X-Ray Astronomy — A Survey of Recent Developments. June 15, 1970. Publication in McGraw-Hill Encyclopedia of Science and Technology 1971 Yearbook.

HOOVER, DR. RICHARD B. et al. S&E-ASTR-RP

Fabrication and Testing of Glancing Incidence X-Ray Telescope Mirrors. March 9, 1970. MSFC/Optical Society of America, Huntsville, Alabama.

HOPPES, ROBERT V. S&E-ME-MW

See Parks, P. G.

HUDSON, DR. O. K. et al. S&E-SSL-S

A Miniaturized Absolute Gravimeter and Its Application. March 9, 1970. AGU Meeting, Washington, D. C.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

Absolute Gravity Measurements or Why You Should Go to College. July 14, 1969. Alabama Mathematics Talent Search Forum, University of Alabama.

Laser Absolute Gravimeter. March 25, 1970. 1970 Electro-Optical Design Conference New York, New York.

Absolute Gravity Measurement Apparatus. September 29, 1969. 1969 Meeting of the Southeastern Section of American Physical Society.

HUFFAKER, ROBERT M. S&E-AERO-AT

Laser Doppler System for Detection of Aircraft Trailing Vortices. March 3, 1970. Proceedings of the IEEE, Vol. 97, March 1970.

Laser Doppler Systems for Measurement of Atmospheric Wind Velocity and Turbulence. January 16, 1970. American Meteorological Society, Huntsville, Alabama.

HUGGINS, CARL T. S&E-ASTR-IP

A Miniature Television Camera Designed With Microelectric Techniques. September 5, 1969. What's New for You — Technology Transfer, Rolla, Missouri.

JAMES, LEE B. PM-DIR

Future Apollo Missions 14-19.

Space Shuttle and Space Station.

The High Road to Space.

The Skylab Program. June 8, 1970. University of Sydney Science Lectures, Sydney, Australia.

JEAN, OTHA C. PD-RV

The Characteristics of the Space Shuttle. April 28, 1970. 16th Annual Meeting of the American Astronautical Society, Anaheim, California.

JENKINS, RODNEY W. S&E-SSL-PO

Nondestructive Testing by Optical Correlation. December 4, 1969. Inter-Center Conference on Holographic Instrumentation Applications. Ames Research Center, Moffett Field, California.

JEX, DAVID W. S&E-SSL-P

Meteoroids — Their Origin, Abundance, and Effect on Our Space Program. December 26, 1969. Marshall County High School Science Club meeting, Guntersville, Alabama.

JOHNSON, WILLIAM G. S&E-R-DIR

Optics at Marshall Space Flight Center. July 18, 1969. Publication in Applied Optics Journal.

JONES, CLYDE S., JR. S&E-ASTR-GD

Traction System Design for a Lunar Roving Vehicle. July 10, 1969. Society of Automotive Engineers, Detroit, Michigan.

Traction Drive System Design Considerations for a Lunar Roving Vehicle. October 28, 1969. Society of Automotive Engineers, Detroit, Michigan.

JONES, JACK A. S&E-COMP-RRV

Discussion of Random Data Reduction and Analytical Systems at MSFC. January 19, 1970. The University of Tennessee Space Institute, Tullahoma, Tennessee.

KADRMAS, K. A. S&E-AERO-F
DAMKEVELA, R. J.

Turbulence Measurements With an Infrared Crossed-Beam System Near 4.3 Microns. January 20, 1970. Publication in AIAA.

KADRMAS, KENNETH A. S&E-AERO-F

See Krause, Dr. Fritz R.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

KAUFMAN, JOHN W. S&E-AERO-YA
ALEXANDER, MARGARET B. S&E-AERO-YA

Measurements During 1966-1968 From NASA's 150-Meter Meteorological Tower Facility at KSC, Florida. May 25, 1970. Publication in Bulletin of the American Meteorological Society.

KAUFMAN, JOHN W. S&E-AERO-YE
SUSKO, MICHAEL S&E-AERO-YE

Review of Special Detailed Wind Profile Measurements. December 29, 1969. Publication in Bulletin of the American Meteorological Society (AMS).

KAUFMAN, J. W. S&E-AERO-YE
HILL, C. K. S&E-AERO-YE

Inphase Characteristics of Winds to 150 Meters. January 20, 1970. AIAA Fourth National Conference on Aerospace Meteorology, Las Vegas, Nevada.

KIEFLING, LARRY A. S&E-AERO-DD

See Ryan, Robert S.

KIEFLING, LARRY A. S&E-AERO-DD

Comments on the Eigenvalue Problem for Structural Systems With Statistical Properties. November 21, 1969. Publication in AIAA Journal.

KING, ALBERTA S&E-AERO-DFR

See Ryan, Robert S.

KROES, R. L. et al. S&E-SSL-TR

Effects of Ultraviolet Irradiation on Zinc Oxide. January 22, 1970. AIAA Fifth Thermophysics Conference, Los Angeles, California.

KROES, R. L. S&E-SSL-TR

The Formation of Defect Centers in MgO. May 12, 1970. AIAA Fifth Thermophysics Conference, Los Angeles, California.

The Formation of Color Centers in MgO. January 22, 1970. AIAA Fifth Thermophysics Conference, Los Angeles, California.

KRAUSE, FRITZ R. S&E-AERO-AF
DERR, VERNER

Remote Probing of Wind and Turbulence Through Cross-Correlation of Passive Optical Signals. October 6, 1969. Sixth International Symposium on Remote Sensing of Environment, Ann Arbor, Michigan.

KRAUSE, DR. FRITZ R. S&E-AERO-F
WILSON, L. N.
KADRMAS, KENNETH A. S&E-AERO-F

Optical Measurements of Sound Source Intensities in Jets. July 10, 1969. Basic Noise Research Conference, Washington, D. C.

KULSHRESHTHA, A. P. S&E-SSL-TR

Effects of Photoexcitation on the Electrical Properties of Zinc Oxide Single Crystals. November 4, 1969. Publication in Transactions on Aerospace and Electronic Systems.

KULSHRESHTHA, A. P. S&E-SSL-TR
MOOKHERJI, T.

Electrical Conduction in Triphenylmethylarsonium and Morpholinium Complexes of TCNQ. January 20, 1970. Publication in J. of Chem. Phys.

Investigation of Electrical Conductivity in Morpholinium Tetracyanoquinodimethan. September 24, 1969. 1969 Fall Meeting of the Southern Section of the American Physical Society. University of Florida, Gainsville, Florida.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

Semiconductivity in β-Alanine. May 11, 1970. Publication in Chem. Phys. Letters.

KURTZ, R. L. S&E-SSL

A Holographic Technique for Recording Hypervelocity Projective Motion. September 9, 1969. Publication in Applied Optics.

LINTON, R. C. S&E-SSL-TR

See Arnett, G. M.

LINTON, ROGER C. S&E-SSL-TR

Computational Methods for Determining Optical Constants of Contaminants on Multilayers Thin-Film Reflectors. March 25, 1970. Electro-Optical Systems Design Conference, New York, New York.

LINTON, R. C. S&E-SSL-TR
MOOKHERJI, T. K.

Optical Properties of Thin Films of Zirconium Diboride. June 10, 1970. American Vacuum Society Meeting, Washington, D. C.

LITTLES, J. W. S&E-ASTN-PLA

Environmental Control System/Orbital Assembly. September 5, 1969. Environmental Engineering Association, Shreveport, Louisiana.

Nucleate Pool Boiling of Freon 113 at Reduced Gravity Levels. April 3, 1970. The Role of Nucleation in Boiling and Cavitation, Detroit, Michigan.

MCCOY, DR. KENNETH E. S&E-ASTN-PTC

The Effect of an Oscillating Pressure on Nucleate Pool Boiling. December 30, 1969. The 1970 Heat Transfer and Fluid Mechanics Institute Naval Post Graduate School, Monterey, California.

MCCRARY, S. E. A&TS-TU

Post-Apollo Engineering — A Challenge for Engineering Education. October 1969. Publication in Professional Engineer.

The Revelation of Saturn-Apollo or an 11th Commandment. March 17, 1970. Transactions of SM 70 Conference, Los Angeles, California.

See Cutchins, Dr. M. A.

MCDONOUGH, DR. G. F., JR. S&E-CSE-A

Status Report on the Orbital Workshop/ATM Program. October 23, 1969. AIAA Conference, Los Angeles, California.

MCQUIRE, JAMES P. S&E-SSL-P

Low Light Level TV Systems on the NASA 1969 Airborne Auroral Expedition. March 3, 1970. 51st Annual Meeting of the American Geophysical Union, Washington, D. C.

MCKANNAN, E. C. S&E-ASTN-MM

Saturn Space Boosters Boost Metal Developments. December 5, 1969. Publication in Professional Engineer.

MCKANNAN, E. C. S&E-ASTN-MM
FABINIAK, DR. RICHARD
FABINIAK, DR. THADDEUS
ABBOTT, DR. ROBERT

Theoretical Considerations for Liquid Phase Sintering and Solidification in the Space Environment. October 23, 1969. Publication in Space Processing and Manufacturing, ME 69-1.

MCKINNEY, B. G. S&E-ASTN-PL

An Odor Removal Study. April 7, 1970. 47th Annual Meeting of Alabama Academy of Science, Auburn, Alabama.

MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are clearance dates.)

MCKINNEY, B. G. S&E-ASTN-PL
SHOUMAN, A. R.

Laser Velocimeter Used To Find Transition Region. May 11, 1970. Publication in AIAA.

MCPHERSON, W. B. S&E-ASTN-MM

Gaseous Hydrogen Environments on the Space Shuttle System. April 24, 1970. IMD-AIME: Effects of Gaseous Hydrogen on Metals, Las Vegas, Nevada.

MARSHALL, T. N. S&E-ASTR-IM

Flow Research for Liquid and Slush Hydrogen. August 25, 1969.

ISA Annual Conference, Houston, Texas.

MASTIN, W. C. S&E-ASTR-GC

See Walls, B. F.

MAY, CHESTER B. PD-MP-S
DAVIS, RAY
FEINDLER, CLAUSE

Control of the Biologically Closed Environment in the Ben Franklin Submersible — A Development Tool for Space Station Technology. October 22, 1969. AIAA Sixth Annual Conference, Anaheim, California.

MENDIRATTA, R. G. S&E-ASTR-IMD

Mossbauer Effect in Some Iron Compounds. February 3, 1970. Publication in Phys. Letters.

Mossbauer Effect in Ferrous Ethylenediammonium Sulfate. December 9, 1969. Publication in Chem. Phys. Letters.

Mossbauer Investigation of Ferrophosphorus. April 3, 1970. Publication in J. Phys. Chem. of Solids.

MOORE, W. WALDING, JR. S&E-SSL-P
TASHBAR, PHILIP W. S&E-SSL-P

Custom System for Measuring Optical Effects of Aerospace Materials Contaminant Deposits. March 3, 1970. 1970 Annual Technical Meeting, American Association of Contamination Control, Anaheim, California.

NAUMANN, DR. ROBERT J. S&E-SSL-P

Comments on Grasshoff's Paper: An Onboard Closed-Loop, Nutation Control System for a Spin-Stabilized Spacecraft. March 4, 1970. Publication in J. of Spacecraft and Rockets.

NAUMANN, ROBERT J. S&E-SSL-P

High Temperature Metallic Equations of State. October 6, 1969. Southeast Section American Physical Society, Gainesville, Florida. (Also publication in Phys. Rev.).

NICOLAS, DAVID S&E-ASTR-RMD

New Techniques for Facilitating SEM Analysis of Microcircuits. March 3, 1970. Utilization of the Scanning Electron Microscope Third Annual Stereoscan Colloquium and IITRI, LaSalle Hotel, Chicago, Illinois.

NORDEN, B. NELSON S&E-SSL-PO

See Williams, John R.

NORRIS, DAVID A. S-I

See Terry, James P.

NOWAKOWSKI, M. F. S&E-QUAL-FP
VILLELLA, FELMINIO S&E-QUAL-FP
BARLOW, WILLIAM R. S&E-QUAL-FP

Fatigue Problem in 1-Mil TC Wedge-Bonded Aluminum Wire. November 20, 1969. 1970 IEEE Reliability Physics Symposium, Las Vegas, Nevada.

MSFC PAPERS CLEARED FOR PRESENTATIONS
(Available only from authors. Dates are clearance dates.)

NURRE, GERALD S. S&E-ASTR-A

Relative Instability of Attitude Equilibria of Earth-Pointing Satellites, Orbiting Within the Earth's Atmosphere. February 11, 1970. 1970 AIAA/AAS Astrodynamics Specialists Conference, Santa Barbara, California.

NURRE, GERALD S. S&E-ASTR-A
DEVRIES, LEONARD L. S&E-AERO-Y

An Experiment To Determine Density Variations in Earth's Atmosphere and Other Atmospheric and Aerodynamic Information. January 6, 1970. Fourth Conference on Aerospace Meteorology sponsored by AMS, AIAA, IES, Las Vegas, Nevada.

An Experiment To Determine Accurately Density Variations in Earth's Atmosphere and Other Atmospheric and Aerodynamic Information. October 13, 1969. Fourth Conference on Aerospace Meteorology sponsored by AMS, AIAA, IES, Las Vegas, Nevada.

ORAN, DR. W. A. S&E-SSL-NR

See Parnell, T. A.

ORAN, DR. WILLIAM A. S&E-SSL-NR

Discrepancies Between the Theoretical and Experimental Energy Loss Distributions of Protons Traversing a 90-Percent Argon 10-Percent Methane Mixture. June 15, 1970. Publication in Physical Review.

OTTO, GUENTHER S&E-SSL-NP

Preparation and Properties of TA_3SN Prepared by Vapor Diffusion. March 25, 1970. 1970 Applied Superconductivity Conference, Boulder, Colorado.

OWENS, JOHN H., JR. S&E-ASTR-C

The Development of an Ultra Reliable Microminiature DC AMP. July 3, 1969. 1969 Government Microcircuit Application Conference.

PALUDAN, C. T. S&E-ASTR-IM

Remote Sensing From Space (Summary). November 12, 1969. SMPTE Winter Television Conference, Atlanta, Georgia.

PARKS, P. G. S&E-ME-MW
HOPPES, ROBERT V. S&E-ME-MW
MASABUCHI, DR. KOICHI

Quality Requirements for Weldments in Saturn V. November 19, 1969. International Welding Institute, Lausanne, Switzerland.

PARNELL, T. A. S&E-SSL-NR
GUENTHER, G. A.
ORAN, DR. W. A. S&E-SSL-NR

A Charged Particle Spectrometer for NASA's First Manned Orbital Workshop. October 14, 1969. IEEE 1969 Nuclear Science Symposium, San Francisco, California.

PATTERSON, WILLIAM S&E-ASTN-PL
HASTINGS, L. J. S&E-ASTN-PFA
WARD, WYLEY

Thermal Control of the Orbital Workshop. August 25, 1969. 1969 SAE National Aeronautics and Space Engineering and Manufacturing Meeting, Los Angeles, California.

PAUL, HANS G. S&E-ASTN-P

Development Trends of Space Vehicle Propulsion in the 1970's. January 6, 1970. 10th International Technical Scientific Meeting on Space, Rome, Italy.

PEOPLES, JERRY A. PD-DO-SI

Rankine Cycle Power Systems for Automotive Application. June 15, 1970. Technology Utilization (AAS), Tokyo, Japan.

POE, J. W. S&E-AERO-AUE
WALKER, R. W. S&E-AERO-AUE
DUVE, G. C. S&E-AERO-AUE

Ground Wind Loads on Saturn Vehicles. November 20, 1969. Fourth Conference on Aerospace Meteorology, Las Vegas, Nevada.

MSFC PAPERS CLEARED FOR PRESENTATIONS
(Available only from authors. Dates are clearance dates.)

POE, JAMES W. S&E-AERO-AU
ODEN, DR. J. T.

On the Numerical Solution of a Class of Problems in Dynamic Coupled Thermoelasticity. March 23, 1970. Fifth Southeastern Conference on Theoretical and Applied Mechanics, Raleigh, North Carolina.

RANDALL, J. L. S&E-ASTR-RP

Atmospheric Effects on Optical Communications Systems. August 1, 1969. Publication in Laser Applications in the Geosciences, Conference Proceedings.

RAUSCHKOLB, HENRY S&E-COMP-RRG

Launch Information Exchange Facility (LIEF)/Huntsville Operation Support Center (HOSC) Real Time Data Processing and Display System. October 14, 1969. General Membership Meeting, Las Vegas, Nevada.

REDMAN, BOB A&TS-MS-G

Development of an Integrated Space Program. April 3, 1970. 17th Annual International Technical Communications Conference, Minneapolis, Minnesota.

Progress With a Purpose. December 2, 1969. 17th Annual International Technical Communications Conference, Minneapolis, Minnesota.

REECE, O. Y. S&E-ASTN-MMM

TZM Wire Reinforced Composites. June 15, 1970. 17th Meeting of the Refractory Composites Working Group, Williamsburg, Virginia.

REID, DR. NEIL M. S&E-SSL-PO

Some Findings on Water Vapor Nucleation in Spacecraft Debris Clouds. February 4, 1970. Publication in Planetary Space Sciences.

The Application of TOFMS to the Study of Homogeneous Gaseous Interactions. September 15, 1969. 11th Annual Bendix Time of Flight Mass Spectrometer Conference, Rochester, New York.

REINEL, KONRAD S&E-ASTR-G

Accelerometer Calibration in the Low g Range by Means of Mass Attraction. February 11, 1970. AIAA Guidance, Control, and Flight Mechanics Conference, Santa Barbara, California.

REMER, IRA A&TS-MS-I

The Space Age Diaskeuast. October 28, 1969. Industrial Editors Seminar, Knoxville, Tennessee.

REYNOLDS, JOHN M. S&E-SSL-TE

Reflection Efficiency of Various Materials at X-Ray Wavelengths. March 30, 1970. 47th Annual Meeting of the Alabama Academy of Science, Auburn University, Auburn, Alabama.

RICHARD, LUDIE G. S&E-DIR

Abstract on Space Flight Navigation. August 1969. Combined meeting of the Royal Astronomical Society and the Institute of Navigation, Macclesfield, Cheshire, England.

ROWE, OWEN S&E-ASTR-RS

An MOS/LSI Analog-to-Digital Converter. January 19, 1970. Fourth NASA Microelectronics Symposium, Langley Research Center, Hampton, Virginia.

RYAN, ROBERT S. S&E-AERO-D

Operational Procedures for Determining Space Vehicle Response to Wind Turbulence. September 22, 1969. Fourth Conference on Aerospace Meteorology, Las Vegas, Nevada.

MSFC PAPERS CLEARED FOR PRESENTATIONS
(Available only from authors. Dates are clearance dates.)

RYAN, ROBERT S. S&E-AERO-D
KIEFLING, LARRY A. S&E-AERO-D
BUCHANAN, H. J. S&E-AERO-D
JARVINEN, W.

Simulation of Saturn V, S-II Stage Propellant Feedline Dynamics. April 29, 1970. AIAA Propulsion Specialist Conference, San Diego, California.

RYAN, ROBERT S. S&E-AERO-D
KING, ALBERTA S&E-AERO-DFR

Wind Induced Loads on a Launch Vehicle — A High Speed Analysis Using Many Wind Profiles. September 23, 1969. Fourth Conference on Aerospace Meteorology, Las Vegas, Nevada.

RYAN, ROBERT S. S&E-AERO-D
PAPADOPOULOS, JAMES
KIEFLING, LARRY A. S&E-AERO-DD

A Study of Saturn AS-502 Coupling Longitudinal Structural Vibration and Lateral Bending Response During Boost. March 3, 1970. Publication in Journal of Spacecraft and Rockets.

SANDLIN, JAMES R. S&E-ASTN-MMA

Photograph — Iron-Cementite Diagram. September 2, 1969. 1969 Materials Engineering Exposition.

SCHOCKEN, DR. KLAUS S&E-SSL-T

Stellar X-Radiation by the Deceleration Process. January 19, 1970. Publication in Proceedings of the Astron. Soc. of the Pacific.

Stellar X Radiation by the Deceleration Process. May 5, 1970. Publication in Acta Physica Austriaca.

X-Ray Astrophysics. May 5, 1970. Publication in Acta Physica Austriaca, Vienna, Austria.

SCHULER, A. E. S&E-ASTR-I

Research Trends in Digital Transducers. March 30, 1970. Fifth International Congress (IMEKOV), Versailles, France.

SELTZER, DR. S. M. S&E-ASTR-A

A Launch Vehicle Stability Analysis Using the Parameter Plane Method. May 1, 1970. Publication in IEEE Transactions (Automatic Control).

Analysis of a Control System Containing Two Nonlinearities. May 14, 1970. Publication in International Journal of Control.

Also December 5, 1969. Third Asilomar Conference, Pacific Grove, California.

Nonlinear Analysis of a Launch Vehicle Attitude Control System. October 20, 1969. Publication in Journal of Spacecraft and Rockets.

Parameter Plane Techniques Applied to Rocket Attitude Control. May 14, 1970. Publication in Institution of Electrical Engineers (IEE).

Parameter Plane Techniques Applied to Tactical Missile Control System Design. October 6, 1969. Eighth Annual IEEE Region 3 Convention, Huntsville, Alabama.

SELTZER, DR. S. M. S&E-ASTR-A
HUANG, J. T.

Parameter Plane Stability Analysis of a Flight Vehicle. December 19, 1969. AIAA Second Aircraft Design and Operations Meeting, Los Angeles, California.

SHARPE, MITCHELL R. PM-SS-MGR

Satellites and Probes. January 9, 1970. Publication by Aldous Books, Ltd., London.

MSFC PAPERS CLEARED FOR PRESENTATIONS
(Available only from authors. Dates are clearance dates.)

SHUKLA, J. B. S&E-SSL-N

The Optimum One-Dimensional Magneto-hydrodynamic Slider Bearing. September 29, 1969. Publication in Transactions of the ASME.

SIEBEL, DR. MATHIAS P. S&E-ME-DIR

Space Manufacturing. February 18, 1970. Third Internationa Conference of Space Technology, Italy.

SMITH, ORVEL E. S&E-AERO-YT

New Meteorological Problems in Aerospace Design and Operations. January 20, 1970. AIAA's Fourth National Conference on Aerospace Meteorology, Las Vegas, Nevada.

SMITH, ORVEL E. S&E-AERO-Y
VAUGHAN, WILLIAM W. S&E-AERO-Y

Review of Meteorological Considerations for Space Shuttle. March 13, 1970. Seventh Space Congress, KSC, Cocoa Beach, Florida.

STEINBERG, ALVIN PM-EP-Q

Reflections on Apollo Reliability and Quality Tactics, Past and Future. September 2, 1969. 24th Midwest Quality Control Conference, St. Louis, Missouri.

STONE, N. H. S&E-SSL-NP
REHMANN, W.

Determination of Plasma Drift Velocity by an Ion Acoustic Wave Technique. May 5, 1970. Publication in AIAA.

STUHLINGER, ERNST AD-S

Electric Propulsion Space Station Attitude Control. September 16, 1969. Orbiting International Laboratory and Space Sciences Conference, Cloudcroft, New Mexico.

STUHLINGER, E. et al S E-SSL

Versatility of Electrically Propelled Spacecraft for Plentary Missions. October 23, 1969. Publication in Journal of Spacecraft and Rockets.

SUSKO, MICHAEL S E-AREO-YS

See Kaufman, John W.

SWENSON, GARY R. S&E-AERO-YS

Diffusion in the Thermosphere: A Case Study. November 20, 1969. Publication in J. Geophys. Res.

Diffusion in the Thermosphere. February 5, 1970. 51st Annual Meeting of the American Geophysical Union, Washington, D. C.

TASHBAR, PHILIP W. S&E-SSL-P

See Moore, W. Walding, Jr.

TERRY, JAMES P.
NORRIS, DAVID A. S-I

The Prevention of Concrete Cement Burns. September 29, 1969. Publication in American Industrial Hygiene Association Journal.

THOMAS, DOUGLAS T. S&E-COMP-CS

Automatic Malfunction Analysis. February 3, 1970. AIAA Test Effectiveness Conference, Palo Alto, California.

THOMASON, HERMAN E. PD-DO-DIR
YOUNGBLOOD, JOHN N.

Nonlinear Effects of a Gas-Bearing Pendulous-Integrating Gyro Accelerometer Under Random Vibration. January 12, 1970. Institute of Navigation, NASA, ERC, Cambridge, Massachusetts.

TRAUBOTH, DR. H. S&E-COMP-CS

MARSYAS — A Software System for the Digital Simulation of Physical Systems. December 12, 1969. Spring Joint Computer Conference, Atlantic City, New Jersey.

MSFC PAPERS CLEARED FOR PRESENTATIONS
(Available only from authors. Dates are clearance dates.)

Real-Time Space Vehicle and Ground Support Systems Software Simulator for Launch Programs Checkout. December 12, 1969. Spring Joint Computer Conference, Atlantic City, New Jersey.

URBAN, EUGENE W. S&E-SSL-N

Flux Flow and a New Critical Current Density. March 23, 1970. 1970 Applied Superconductivity Conference, Boulder, Colorado.

Magnetic Flux Flow in Type II Superconductors. October 6, 1969. Southeastern Section of the APS, University of Florida, Gainesville, Florida.

Oscillatory Magnetic Instabilities in Type II Superconductors. October 6, 1969. Southeastern Section of the APS, University of Florida, Gainesville, Florida.

VARNEDOE, W. W. S&E-ASTN-S

Fire in Space. May 15, 1970. Publication in Fire Engineering.

VAUGHAN, O. H. et al. S&E-AERO-Y

Martian Surface Temperature and Polar Cap Predictions for Mariner VI and VII Encounters. July 14, 1969. Publication in Science.

VAUGHAN, WILLIAM W. S&E-AERO-Y

See Smith, Orvel E.

VILLELLA, FELMINIO S&E-QUAL-FP

See Nowakowski, M. F.

VON PRAGENAU, GEORGE L. S&E-ASTR-A

Stability of Constant Gain Systems With Vector Feedback. April 21, 1970. Seminar at the Institute of Technology, Vienna, Austria.

Stability of Constant Gain Systems With Vector Feedback. November 20, 1969. Publication in Journal of IEEE Transactions (Automatic and Control).

VON PUTTKAMER, JESCO S&E-AERO-T

Recent Trends in Launch Vehicle Recovery — Ballistic and Lifting. August 28, 1969. AGARD/DFVLR/DGLR — Symposium on Aerodynamic Deceleration, Braunschweig, Germany.

WAGNER, HERMANN R. S&E-ASTR-MM
BOURGEOIS, E. J.

The Cinching Mechanisms for the Apollo Telescope Mount Solar Wings. December 3, 1969. Fifth Aerospace Mechanisms Symposium, Goddard Space Flight Center, Greenbelt, Maryland.

WALKER, R. W. S&E-AERO-AUE

See Poe, J. W.

WALLS, B. F. S&E-ASTR-GC
MASTIN, W. C. S&E-ASTR-GC
BROUSSARD, P. H., JR. S&E-ASTR-GC

Laboratory and Field Tests of a Lunar Surface Navigation System. June 18, 1970. ION 25th Anniversary Meeting — Role of Man in Navigation, U.S. Air Force Academy, Colorado Springs, Colorado.

The MSFC Experimental Development Program for Lunar Surface Navigation Equipment. February 18, 1970. National Space Meeting of the Institute of Navigation, NASA Ames Research Center, Mountain View, California.

WEGNER, U. E. S&E-SSL-TR

Crystal Fluorescence in Chrysene. April 21, 1970. Publication in J. of Electro Chem. Soc.

WEIDNER, D. K. et al. S&E-AERO-YS

Martian Surface Temperature and Polar Cap Predictions for Mariner VI and VII Encounters. July 30, 1969. Publication in Science.

MSFC PAPERS CLEARED FOR PRESENTATIONS
(Available only from authors. Dates are clearance dates.)

WEIDNER, DON K. S&E-AERO-YS

An Improved Model of the Thermosphere (90- to 1000-km Altitude). September 23, 1969. National Fall Meeting of the American Geophysical Union, San Francisco, California.

See Butler, J. H.

WEIDNER, DON K. S&E-AERO-YS
ANDREWS, L. E. S&E-AERO-YS
LOU, G.

Upper Atmospheric Model Improvement Studies. February 5, 1970. 51st Annual Meeting of the American Geophysical Union, Washington, D. C.

WEIDNER, DON K. S&E-AERO-YS
CHAMBERS, JOHN L.

An Improved Static Diffusion Model of the Thermosphere. January 20, 1970. AIAA 4th National Conference on Aerospace Meteorology, Las Vegas, Nevada.

WEST, EDWARD A. S&E-SSL-TE

See Fountain, James A.

WHITACRE, W. E. PD-SA-O

Orbital Propellant Depot System. February 26, 1970. 1970 Cryogenic Engineering Conference, University of Colorado, Boulder, Colorado.

WHITE, ROBERT A. S&E-ASTR-ME

High Density of Micro-Logic Flatpacks Using High Density and Low Cost Technique. March 10, 1970. NEPCON Central, Chicago, Illinois.

High Density Packaging of Micro-Logic Flat Packs Using High Density and Low Cost Techniques. August 8, 1969. National Electronic Packaging Conference (NEPCON 70 West), Los Angeles, California.

WILHOLD, G. A. S&E-AERO-AU

Acoustic Research Activities at MSFC. July 10, 1969. Basic Noise Research Conference, Washington, D. C.

WILKENSON, WILLIAM E. PM-SAT-E

See Beaman, Robert E.

WILLIAMS, JOHN R. S&E-SSL-PO

Nondestructive Testing by Holographic Interferometry. December 1, 1969. Inter-center Conference on Holographic Instrumentation Applications, Ames Research Center, Moffett Field, California.

Also March 3, 1970. MSFC/Optical Society of America, Huntsville, Alabama.

WILLIAMS, JOHN R. S&E-SSL-PO
NORDEN, B. NELSON S&E-SSL-PO

Holographic Analysis of Contaminate Deposits on Optical Surfaces. June 29, 1970. Optical Society of America, Hollywood, Florida.

WILSON, ROBERT M. S&E-SSL-TE

Descriptive Survey of Identified X-Ray Sources. March 30, 1970. 47th Annual Meeting of the Alabama Academy of Sciences, Auburn University, Auburn, Alabama.

WUENSCHER, HANS F. S&E-ME-DIR

Unique Manufacturing in Space Environment. March 17, 1970. Seventh Space Congress, Cocoa Beach, Florida.

WYMAN, CHARLES L. S&E-ASTR-RP

A Multiple Purpose Scanning Laser Radar for Space. March 9, 1970. MSFC/Optical Society of America, Huntsville, Alabama.

An Advanced Laser Tracking Technique for Future Space Guidance Systems. October 20, 1969. Publication in AIAA Journal of Spacecraft and Rockets.

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